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MACHINE DESIGN

AS IT AFFECTS

ENGINEERING—PRODUCTION—SALES

MODERN MACHINERY CALLS FOR MODERN METALS

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NICKEL

LENDS A HAND

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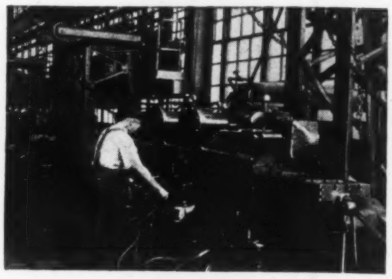
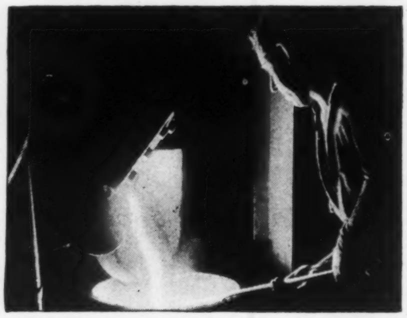
When Nickel is correctly alloyed with other metals, a wide range of improved properties is obtained—properties that assure increased resistance to heat, stress, fatigue, erosion, corrosion, abrasion and wear.

The alloys containing Nickel embrace a variety of compositions, each carefully determined by exhaustive laboratory and service tests. And wherever equipment is thoroughly modern, you are certain to find Nickel Alloy Steels, Nickel Cast Irons, Nickel Bronzes, Stainless Steels, etc., serving a wide range of purposes.

Their use, however, is by no means confined to the manufacturing industry. Alloys containing Nickel are extensively used today in every industry where machines must have greater endurance and greater dependability.



And when you consider all the advantages of alloying with Nickel, the extra cost is really small in relation to the benefits secured. In most cases only a little Nickel (from ½% to 5%) is required to produce definitely superior mechanical properties.



Nickel Alloy Steels

Among the most widely used alloys containing Nickel are the Nickel Alloy Steels. Tons and tons are used in the manufacturing industry because of their exceptional toughness and strength, and their high resistance to stress, heat, pressure, shock and wear.

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MACHINE DESIGN

FRANKLIN H. JOHNSON
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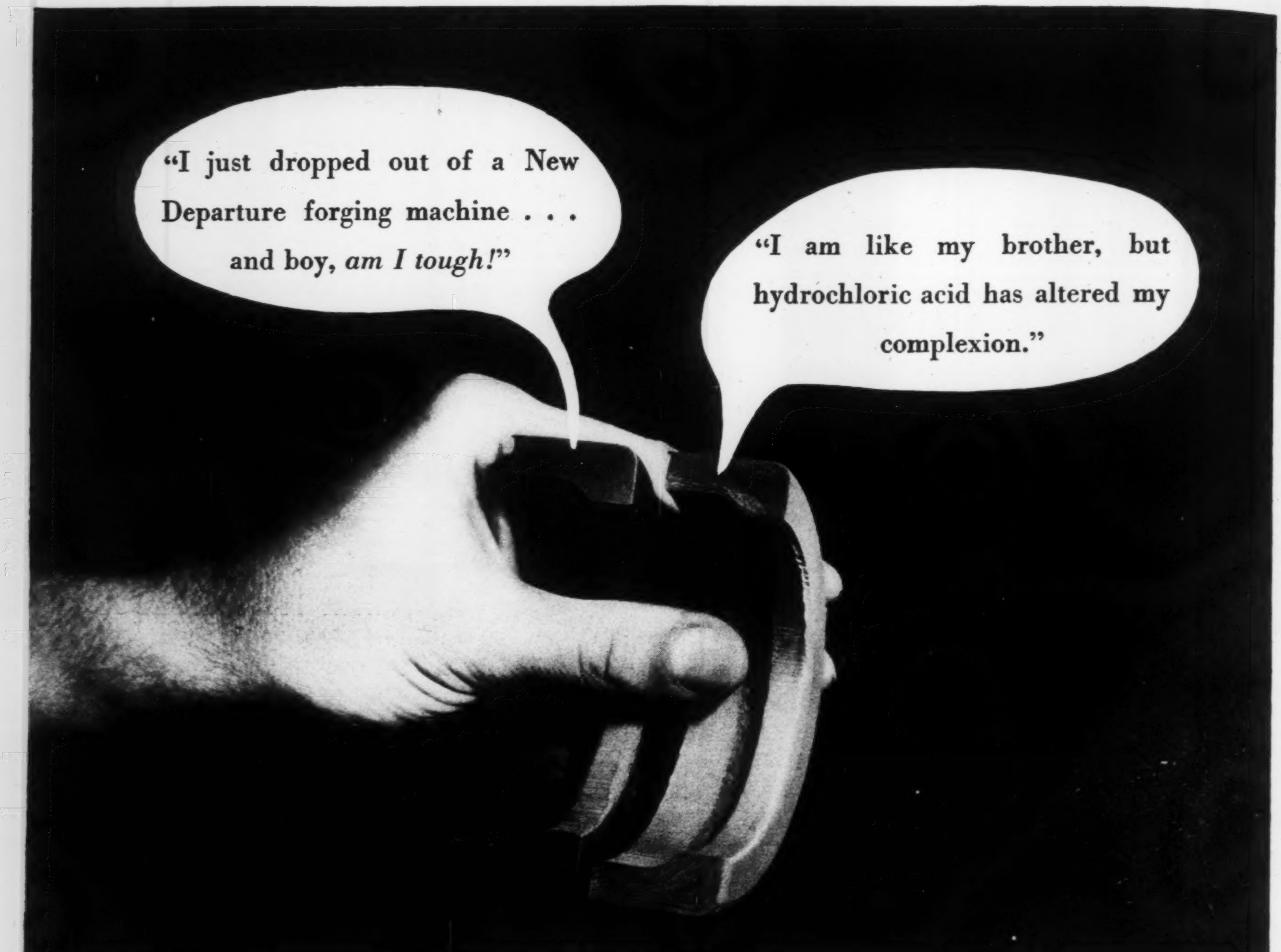
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NEW DEPARTURE

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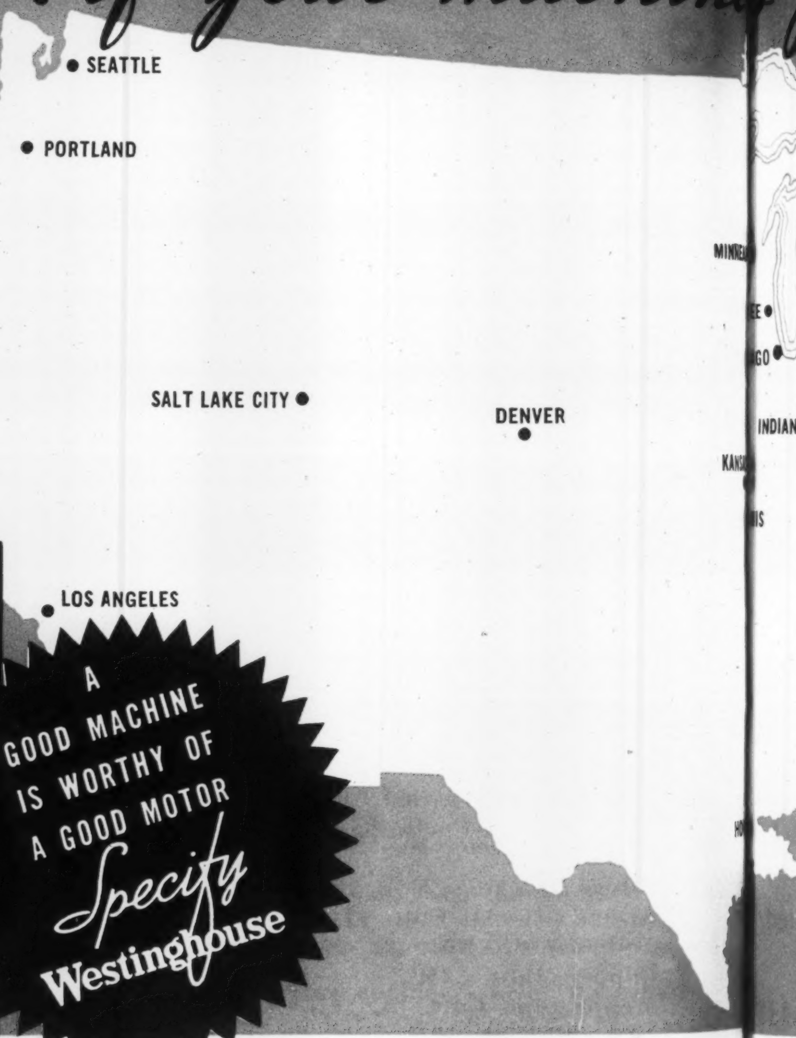

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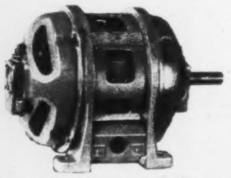

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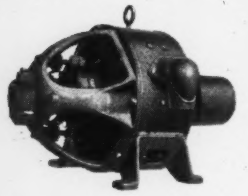

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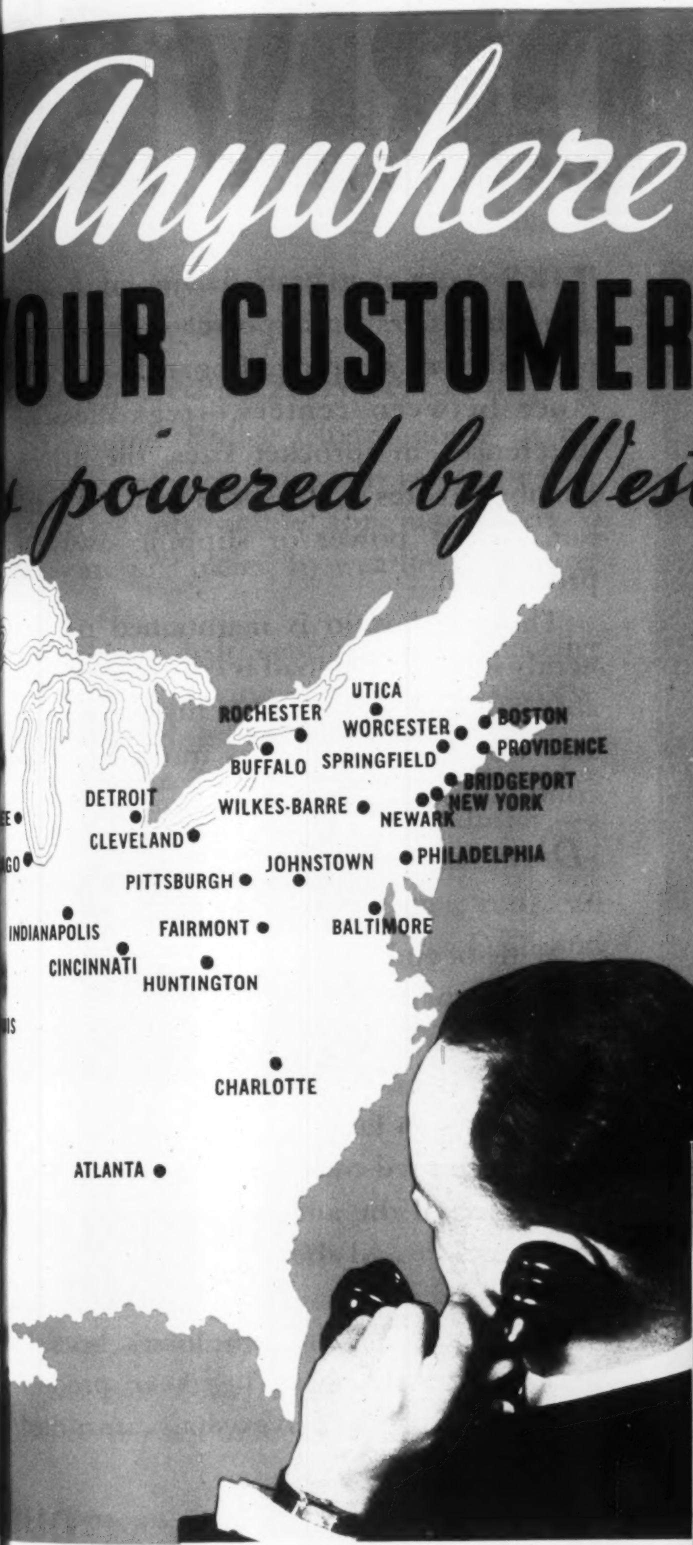
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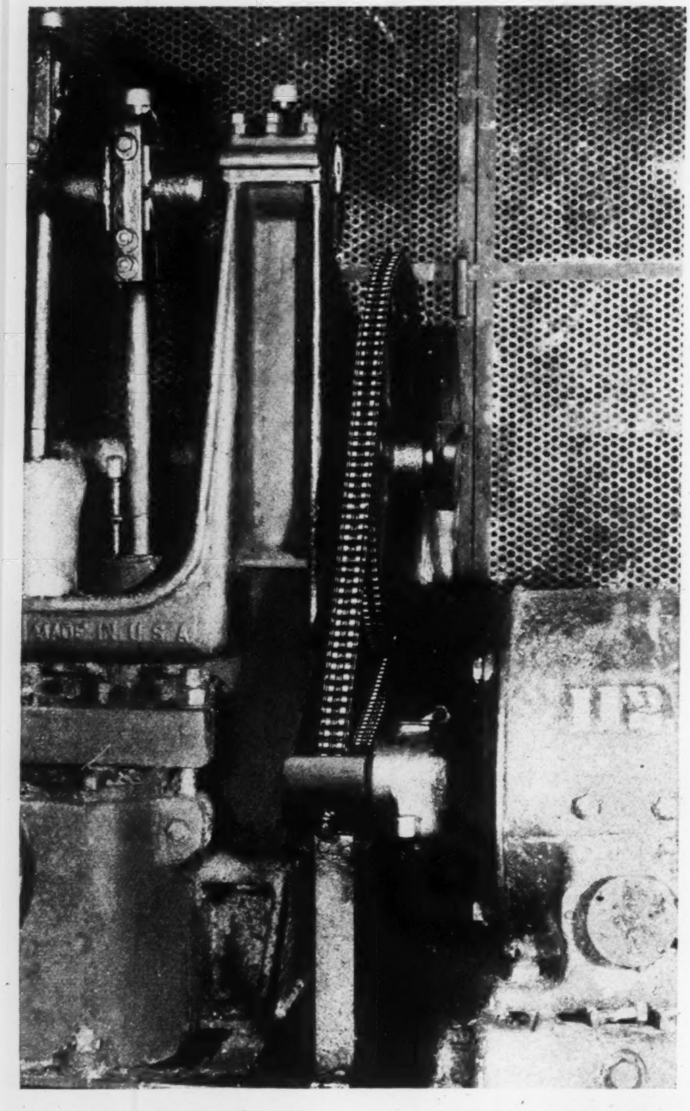

This Diamond Roller Chain Drive was installed because previous drive was unsatisfactory, on pulp pump in a sugar refinery. 1100 R. P. M. 5 Hp.

LIKE claws that grab, Diamond Roller Chains transmit power without any possibility of slipping. Regardless of distance between centers,—regardless of differences in sprocket sizes, the driven member rotates at the speed selected without loss of power or slipping away of production.

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They save production losses because they stay on the job. They keep production up because the driven shafts are turned

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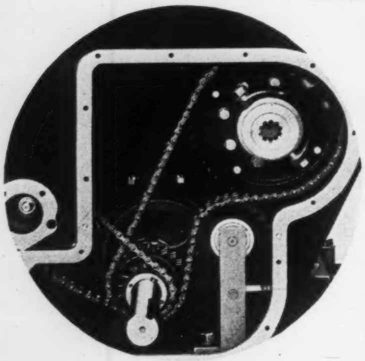

On Diesel engines Diamond Chain is standard on many makes. Here there must be extreme accuracy of timing, extreme dependability to insure engine performance.

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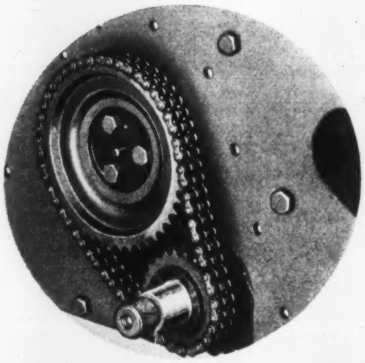

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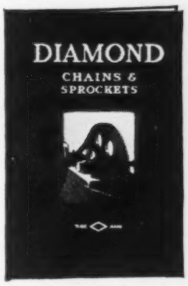

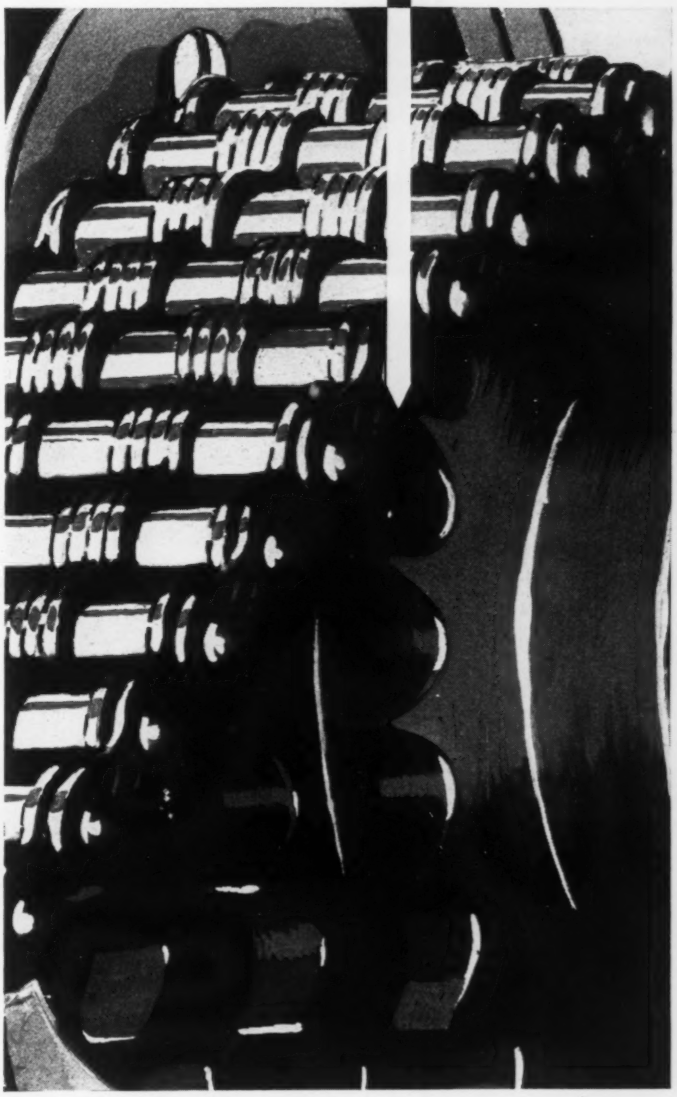

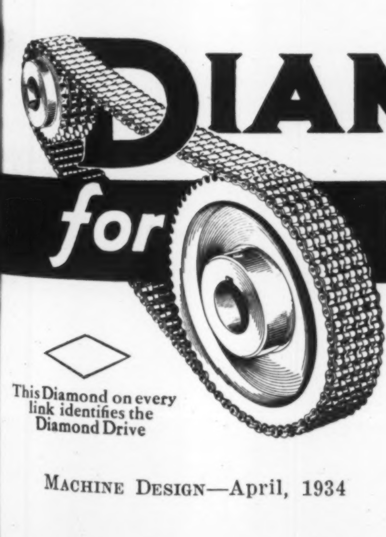

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LEADERS in business, production and design, express the trend for 1934 as being toward lower manufacturing costs. Production economies can only be obtained through the use of highly modernized machines, not only more automatic in operation, but that run faster and turn out a better product at a lower cost.

These new production standards not only affect machine design, but greatly increase the importance of proper bearing selection and installation. Bearing development must keep pace with the latest trend in machine advancement; and the successful design engineer should be equipped with the latest ball bearing information.

The Marlin-Rockwell Corporation offers the wide experience of three pioneer ball bearing manufacturers and can supply practically every type of ball bearings required for the successful solution of modern shaft support problems.

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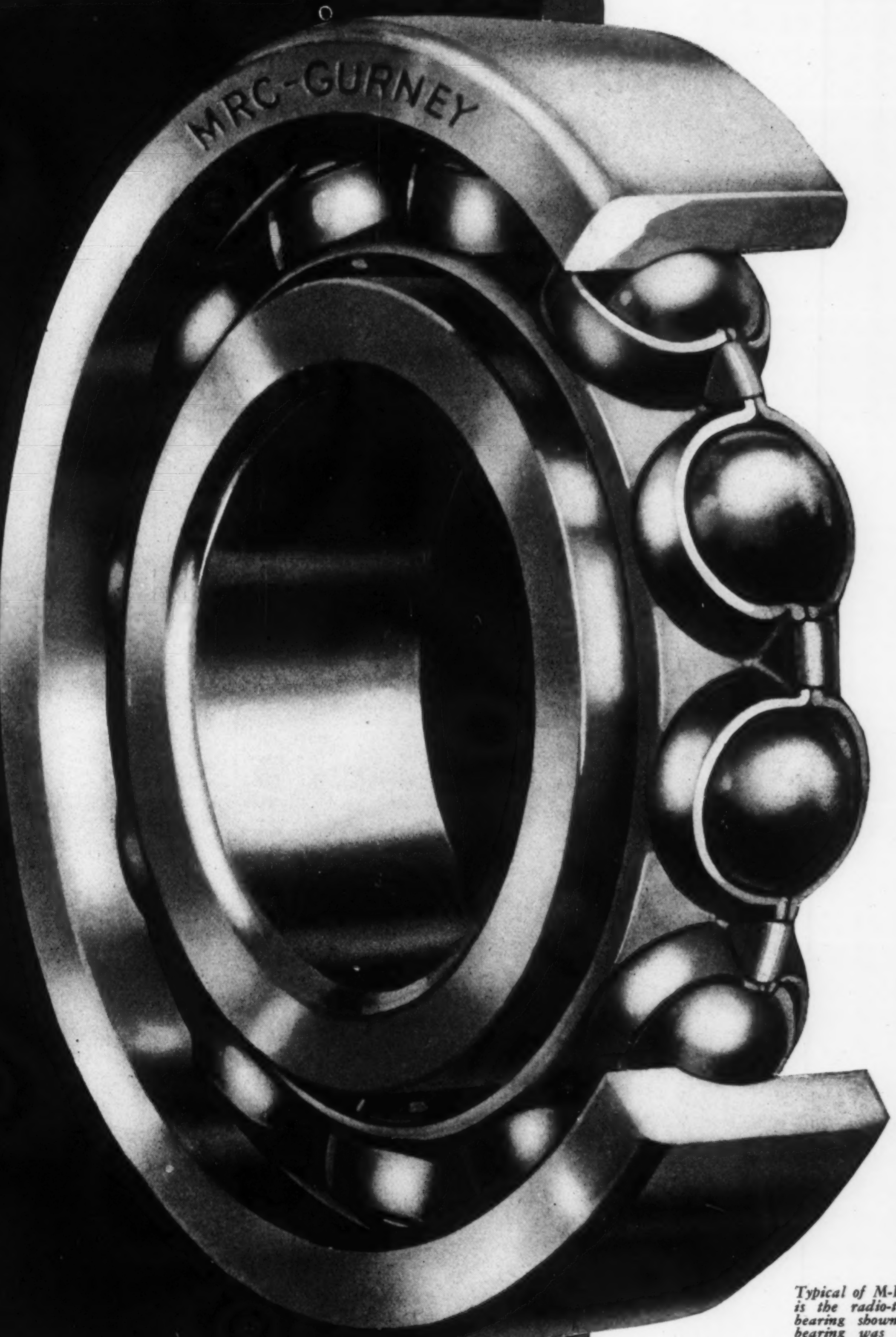

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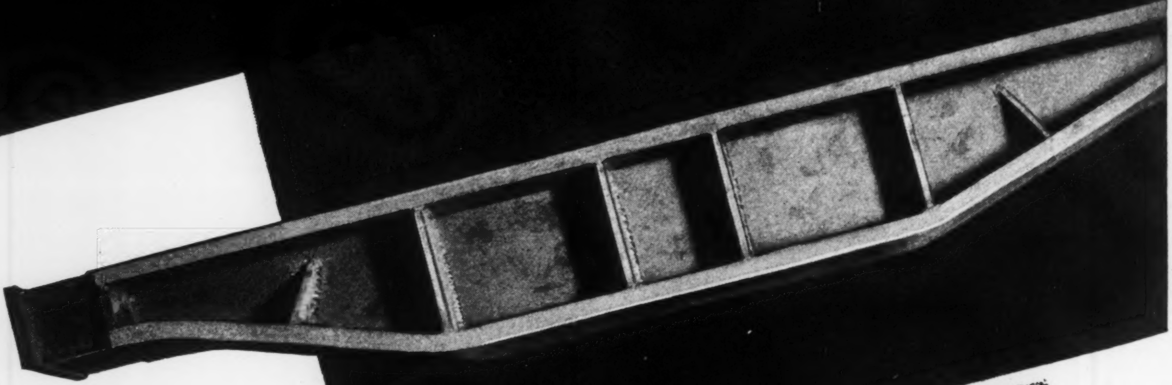

Don't complicate the job by tedious and expensive fabrication when a rolled section can be used. The saving in the amount of welding is strikingly illustrated in the accompanying photograph and blueprint. The Wellman Engineering Company, who built a number of these patented bolsters for heavy duty trucks, writes: "We certainly appreciate your doing about 75% of the fabrication by laying those 14"-237 pound H Beams down in our shop. We torched out part of the web, bent down the flange, welded in the stiffeners and boxed up the ends. Heavy rolled sections are finding their way into much of our welded mechanical equipment because of the increased strength and low cost."

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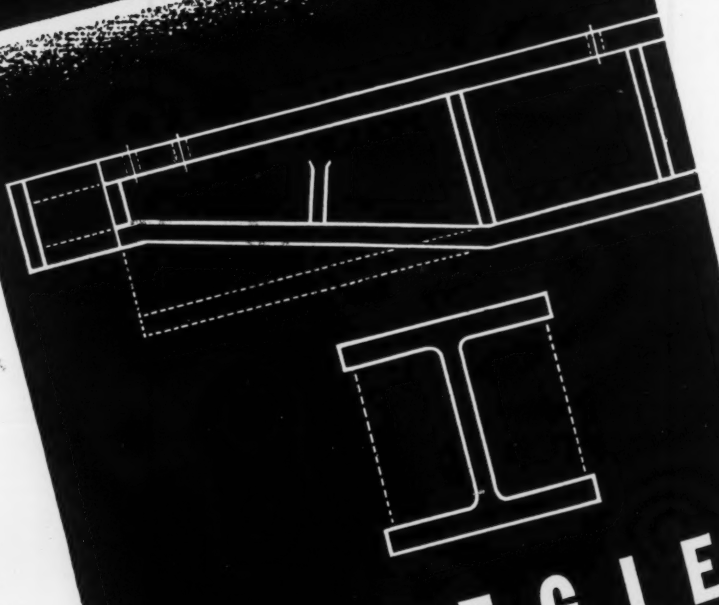

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MACHINE DESIGN
THE JOHNSON PUBLISHING CO., CLEVELAND, OHIO
April, 1934 Vol. 6—No. 4

Materials Choice Cuts Weight, Stops Corrosion

By Henry T. Scott
Chief Engineer, The American Paper Bottle Co.

AFTER a designer has visualized the mechanisms for performing mechanical movements necessary in carrying out the functions of his machine, one of the most important problems confronting him involves the selection of materials. While each industry has certain conditions peculiar to it there remain many factors common to all. The dairy field is no exception and primarily because milk has a highly corrosive effect on some metals, the materials question is particularly significant.

Augmenting this consideration is the necessity for reduction in weight. The flywheel effect of heavy rotating parts moving intermittently imposes another problem that may be solved from the materials angle. By the choice of some of the lighter compositions, such as the magnesium alloys, the designer can save himself redesign or perhaps costly additional equipment to counteract the momentum of a rotating mass of mechanism which must be stopped and started intermittently.

All food industries including the dairy are characterized by the absolute necessity for cleanliness. In fact one of the prerequisites of machines built for this class of service is that they be designed to meet this condition. Frequent sterilization must be effected. Because this is commonly done with steam up to 70 to 80 pounds pressure, the parts of the machine undergoing cleansing treatment must be capable of

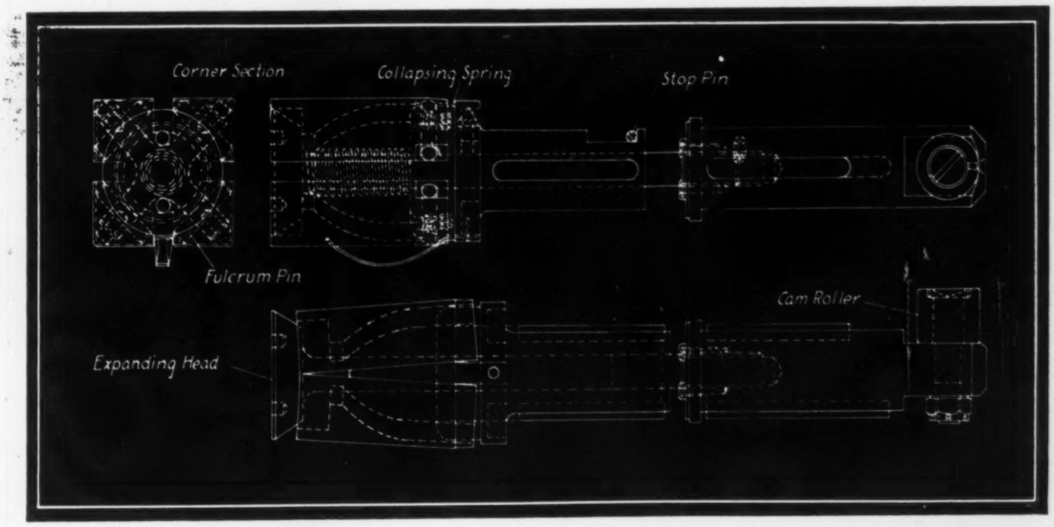


Fig. 1—Collapsible type mandrel is actuated by springs and cone piece to hold the bottles being processed

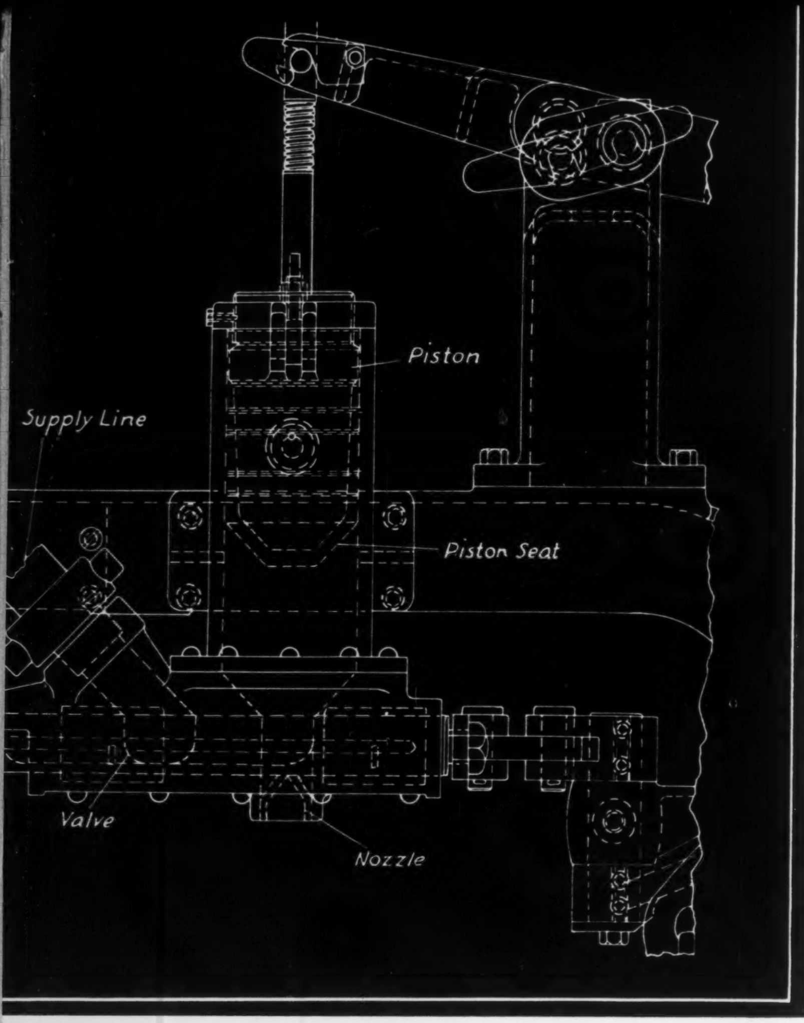


Fig. 2—Cast parts in filling mechanism are fabricated from alloy that resist corrosion

resisting the corrosive effects imposed on them.

Some of the solutions to the foregoing problems will be treated in the following, which refers particularly to an automatic machine for bottling milk in paper containers. This same machine can be employed for packaging any other dairy products as well as frozen fruit juices, coffee, paints, lubricating oils, etc. The American Paper Bottle Co., Toledo, developed the unit, *Fig.* 3.

Magnesium Alloys Reduce Weight

One of the mechanisms in which reduction in weight is accomplished is the revolving spider, *Fig.* 4, which is at the extreme front end of the machine where the paper bottles are formed and the bottoms sealed. Weight of the rapidly indexing mandrel-spider-slide assembly, 1127 pounds with ordinary materials, was reduced to 562 pounds by employing Dowmetal for all castings comprising the revolving mechanism. Thus the start-stop load was reduced to a minimum.

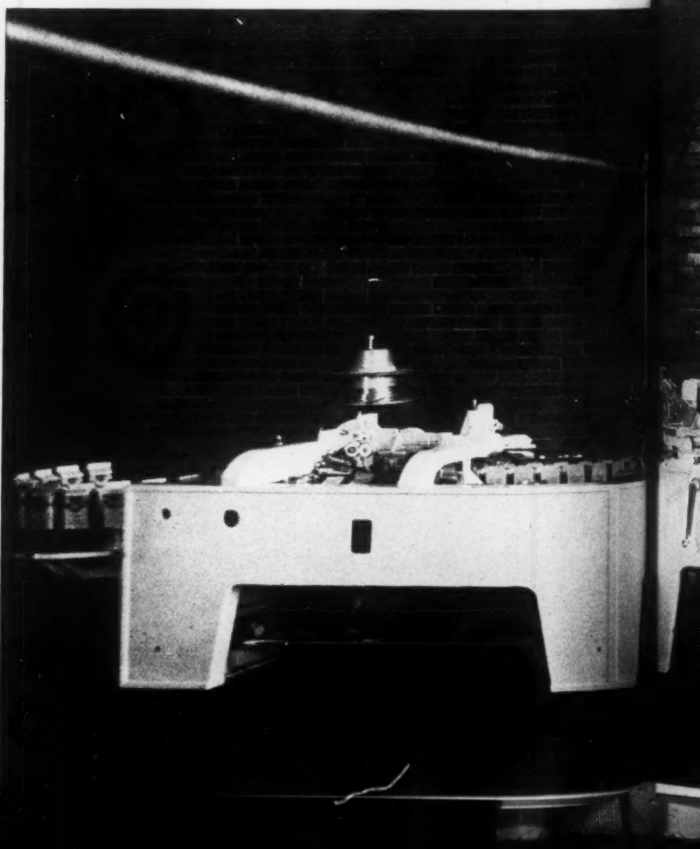
Other important features of the machine will be treated in their order of appearance in the operating cycle, which it is necessary to give in order to cover the design in logical sequence. In operation, the flat bottle blanks are placed on edge in an automatic feeder, and after being opened with the two minor flaps folded in, are rotated to a vertical position and dropped down a rectangular chute shown in *Fig.* 4. To seal the two major flaps of the bottom of the paper container it was necessary to devise a mechanism which would hold the bottle while this was being accomplished. The mandrel, *Figs.* 1 and 4, which provided the solution, had to be of the collapsible type so that the bottle coming down the chute, top end down, could slip over it easily.

The type of collapsible mandrel employed is depicted in *Fig.* 1. It is comprised of four 90-degree angular members or corner sections mounted on fulcrum pins. These upright members normally are tilted inward by the action asserted by small springs engaging the lower ends of the corner sections. As soon as the bottle has seated itself on the mandrel a reciprocating finger actuated in a cam groove that runs spirally in figure-eight manner up and down a revolving shaft, engages the expanding head, forcing it downward to expand the sides of the mandrel to the size of the paper bottle interior. The reciprocating finger holds the plunger in depressed position until the spider is indexed, at which time a roller on the lower end of the mandrel assembly enters a cam track to maintain the expanded position of the mandrel while the major flaps of the bottle are being folded together by slides actuated by cams, *Fig.* 4

Disk Is Raised Positively

When the mandrel has been carried through the various steps the cam has a rise which positively raises the disk to the desired height, permitting the corner springs to collapse the corn-

Fig. 3—Paper bottle machine forms the bottles, fills them and seals them in continuous order



ers. At the loading position, however, the path of the cam is interrupted, or offset. Due to this interruption means must be provided to hold the stem up. This is accomplished by a spring which has just enough tension to balance the weight of the mandrel expanding disk assembly after it has been raised by the cam.

Indexed by a geneva mechanism, the revolving spider carries eight of these mandrels under a stationary shoe. This folds out the two major flaps which then pass under glue rolls to receive a thin film of waterproof adhesive on their inside surfaces. The gluing rolls are set with a spacing of 0.001 inch between them and turn toward one another. The smaller roll substitutes for the conventional glue roll scraper.

Rolls Are of Stainless Steel

In the early machines difficulty was experienced in obtaining a material for the glue rolls. Brass was tried but the corrosive effect of the glue on this metal decreed against its further use. The new rolls are made of stainless steel and are mounted on ball bearings. Their ends are burnished and work hardened to prevent galling; they are operated against hardened stainless steel plates. Since this design was adopted no difficulty has been experienced with the gluing rolls.

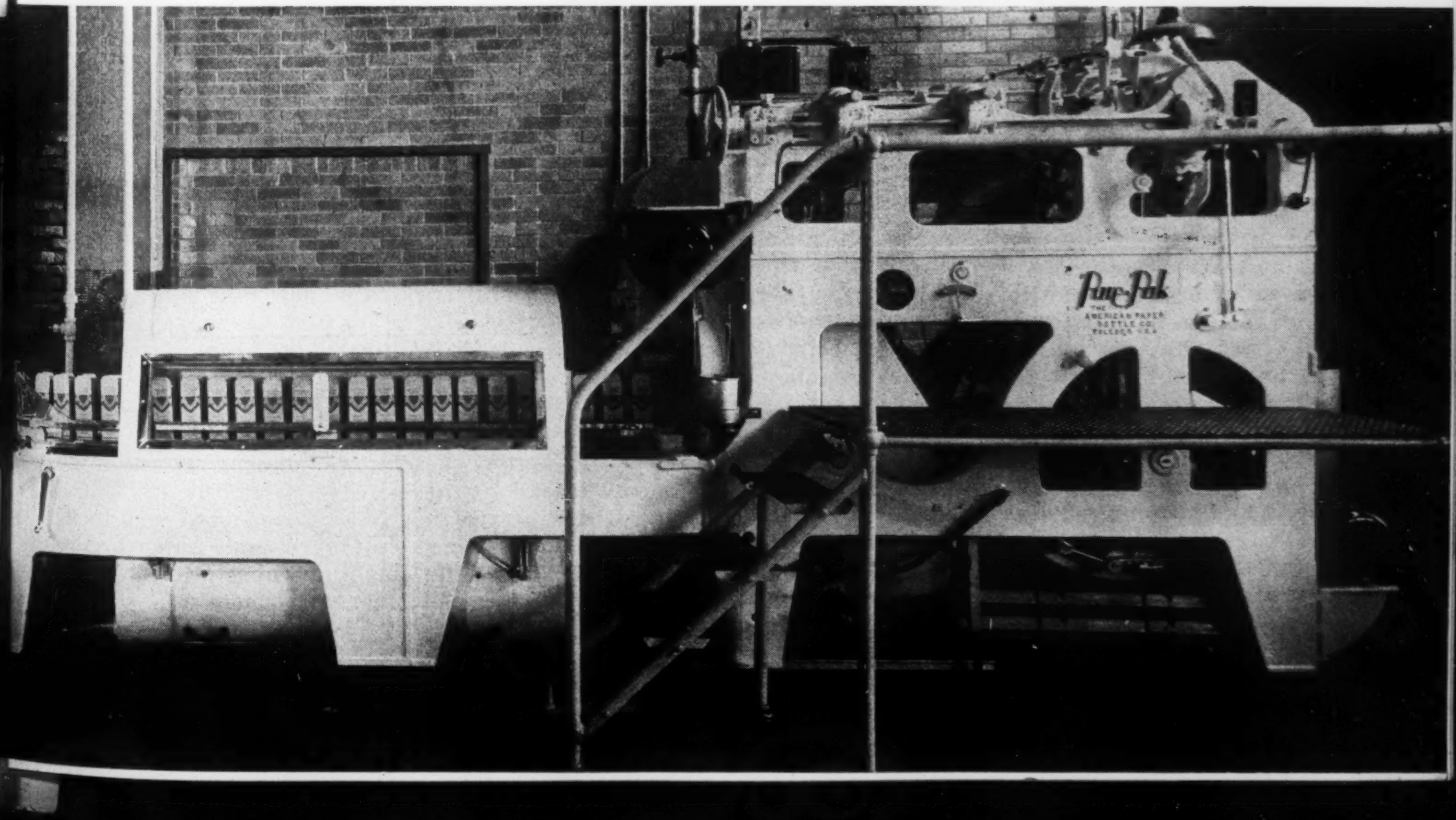
As the spider moves step by step through 360 degrees the slides, *Fig.* 4, follow the contour of their respective cams to fold first one flap and then the other to close the bottom of the bottle. During this time the adhesive on the bottle flaps has time to set and as the last station is reached a pair of fingers remove the container from the now collapsed mandrel, transferring it to the paraffining mechanism.

An interesting innovation is connected with the tank containing the melted paraffin into which each bottle is immersed. To maintain a sterilizing temperature and also hold the level of the paraffin high enough to insure complete immersion, detector devices must be provided. These two functions formerly were performed by separate units, a mercury switch to measure the level of the molten liquid and a bulb thermostat switch to indicate the temperature. Now however, only the bulb thermostat switch is employed. It was found that by placing the bulb at the desired low level for the paraffin it would serve as a control for both temperature and liquid level.

In order to eliminate the possibility of operator's negligence harming the mechanism, the thermostat is arranged to operate electric contacts in series with the stop circuit of the magnetic starter. When the paraffin breaks contact with the bulb of the thermostat a drop in temperature occurs, opening the contacts and stopping the machine. The same thing occurs if the paraffin temperature falls while in contact with the bulb. If someone should attempt to start the machine when the paraffin is cold or too cool, a great deal of damage would occur. With the controls arranged as described, the machine cannot be started until both the liquid level and the temperature are high enough to cause closing of the contacts.

Paraffined Bottles Are Cooled

Leaving the paraffin tank the bottles are pushed between two sets of endless stainless steel conveyor chains having horizontal conveying lugs and supported by knife-edged rolls. The chains have thin semicircular lugs which hold



the bottles upright, but provide only point contact, preventing deposition of paraffin on other parts. To cool the paraffined bottles, the endless chain carries them through a refrigeration compartment. This enclosed unit is constructed of nonmetallic laminated material with rock wool interposed between the panels to act as an insulator. Because of precipitation of moisture in the refrigerator the rails which guide the bottles are chromium plated to resist corrosion.

From the cooling conveyor the bottles are taken to the filling conveyor, also of stainless steel. Here they are gripped by a pair of die cast chromium plated lugs and moved by intermittent stages through a mechanism which redefines the top score to facilitate closing.

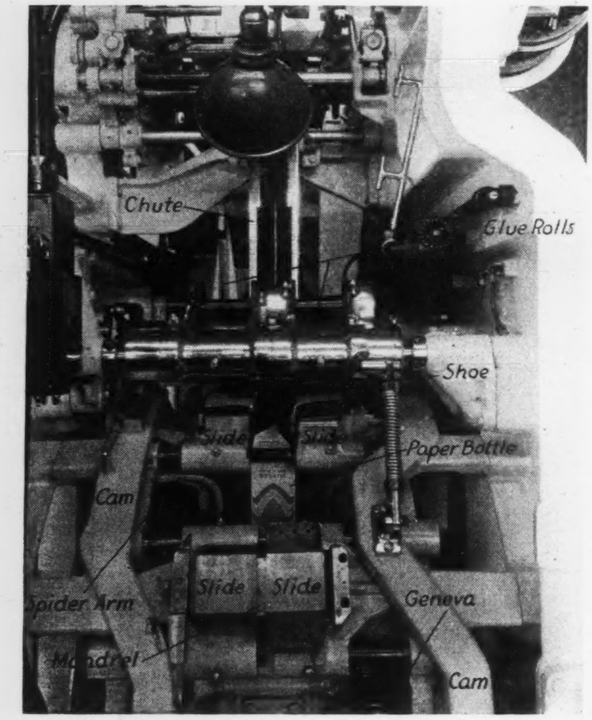


Fig. 4—Light weight alloys are used in rotating spider assembly to combat inertia and momentum

Alloys Used in Food Contacts

At this point the bottles reach the filling station. Except for the bottle filling unit which is made of a special alloy developed for this service, all parts that come in contact with food are 18 per cent chromium and 8 per cent nickel. Those members not likely to be splashed with food are made up of stainless steel having 14 per cent chromium, with low carbon content where soft parts only are needed and high carbon content where they are hardened.

As mentioned earlier in the article, sterilization is an essential procedure before and after the machine has been in operation. Therefore it was necessary to design the filling mechanism, *Fig.* 2, so that it can be disassembled easily and cleansed with high pressure steam. Because of the corrosive action that ensues, the cast parts require an alloy that resists this condition and is free of surface imperfections. A material that is also capable of taking a high polish and holding it permanently is essential. For these properties an alloy comprised of copper, lead, iron, nickel, manganese and zinc was developed. The composite is readily machinable, like brass.

To obtain positive volumetric measure several designs were considered. The principal difficulty lay in developing a mechanism that would exclude the presence of air and also gage accurately a predetermined amount of buttermilk or cottage cheese as readily as milk. Referring to *Fig.* 2, a supply pipe is connected direct to the milk tank. The reciprocating valve, which consists essentially of a recess in a flat bar, operates through linkage by a cam. At its innermost position it shuts off the supply of milk which is constantly available through the pipe. The piston during the shutoff period moves downward until it seats on the bottom surface. Thus any area into which air pockets might form are eliminated. Subsequently the valve is moved under the cylinder, forming a passage between the supply pipe and the cylinder bore; the piston rises, drawing with it the volume of milk the device is set to receive. It will be seen that in this procedure no air can enter. No packings are employed; metal seals are obtained by lapping the flat surfaces to a 90 per cent bearing surface.

Churning Effect Obviated

After the piston has completed its upward travel the reciprocating valve returns to its innermost position and the piston again moves downward to discharge the milk through a specially designed nozzle, *Fig.* 2, into the bottle which has stopped momentarily below it. The nozzle is divided into two parts, one channel directed to each side of the bottle. By employing this principle the milk runs down the sides of the bottle without causing a churning effect. The ends of the two passages have sharp corners, which prevent drippage.

After filling is completed, the top of the container is folded and a stapling operation performed to close the bottle which then is conveyed to a rib squeezing vise that applies 865 pounds pressure. In localities where law requires dating of the bottles the stationary jaw of the vise may have the day of the week engraved on its face. A dovetail slide in the jaw is provided for changing dates.

In keeping with clean appearance the machine is finished in white enamel with the lower extremities of the cast frame bordered in black. Cadmium plating is employed as a finish in the front section of the machine where milk or other food products do not contact the parts.

SCANNING THE FIELD FOR IDEAS

IS USUAL TRANSMISSION DOOMED?

INFLUENCE of the fluid flywheel or hydraulic coupling (M. D. Sept., 1930) in the automotive and industrial fields is becoming more widespread. Eaton Mfg. Co., Cleveland, has arranged with the British patent owners for use of this device in the United States. The mechanism, *Figs.* 1 and 2, is based on the principle of using oil in transmitting power from the driving to the driven element, an idea that is of particular interest to engineers.

Austin M. Wolf, prominent New York automotive consulting engineer, tells MACHINE DESIGN that the fluid clutch might become a factor in this country as in England where it already has been adopted on small cars and even on a motorcycle. The Daimler fluid flywheel represents the first and simplest form of the device, whereas the Leyland torque converter, recently placed in production by an established manufacturer of commercial vehicles, is a later development of this principle. All multiplication of engine torque for acceleration and hill climbing is effected hydraulically.

It is Mr. Wolf's belief that such devices will come into use before the ideal transmission arrives. The Radcliff clutch similar to the Daimler device was introduced in this country prior to the war but evidently was far ahead of its time. So far, he declares, all automatic transmissions have been too complicated or their efficiency has been poor.

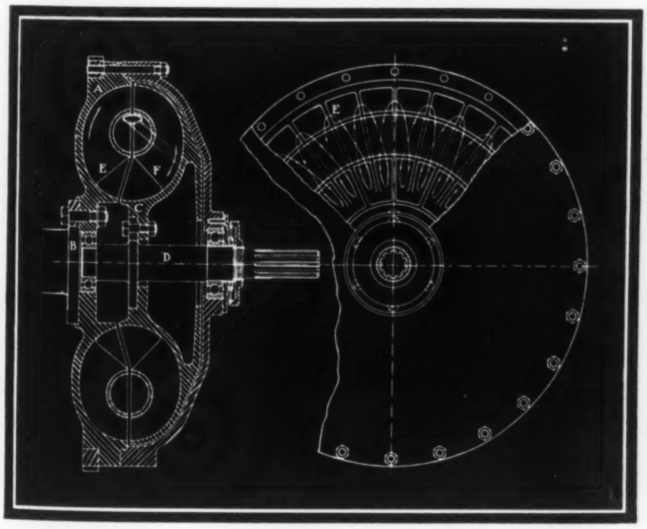


Fig. 1—Oil is used to transmit power from the driving to the driven element in fluid flywheel

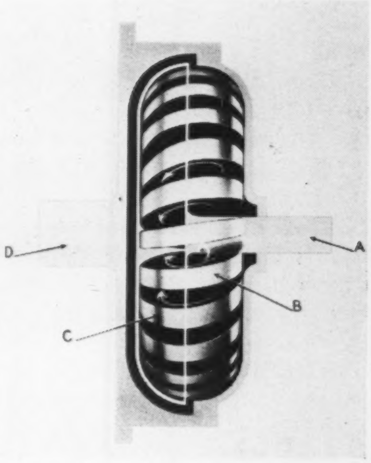


Fig. 2—Simplified drawing of fluid coupling in which oil is rotated by centrifugal force, following a passage in shape represented by the spring-like bands. In so doing the oil passes over from the driving half of the unit to the driven half to turn the latter

The fluid flywheel is really a fluid coupling. It does not supplant the flywheel that is ordinarily seen on internal combustion engines, but generally forms part of it. Taking the place of the clutch on the automobile, the device cushions shocks, and any increase in load is automatically taken care of by an increase in slippage of the coupling elements in the fluid.

By referring to *Fig.* 1, a better understanding can be obtained of Eaton's fluid flywheel. Driving member *A* is attached to crankshaft *B;* driven member *C* to tail shaft *D*. Both members have radial vanes *E* and *F*. In *Fig.* 2, *A* represents the transmission shaft, *B* the driving half of the coupling and *C* the driven portion inside the flywheel and attached to *A*. The crankshaft is designated by *D*.

Cavities between the members are filled about two-thirds with oil. When the engine is running there is a constant circulation of oil in the direction of the arrows, *Fig.* 1. Oil in the driving member *A* acquires kinetic energy as it travels outwards, and gives it up in the form of thrust against the vanes of the driven member *C* as it returns. When the engine is idling the thrust exerted against the vanes of *C* is practically nothing, hence *C* remains at rest. As the engine speed increases the thrust rapidly increases until *C* takes up the drive. The difference in speed between the driving and driven members amounts only to two or three per cent at maximum speeds.

It is unlikely that climatic conditions will restrict the use of the hydraulic device as undoubtedly a new oil will be developed along the line of shock absorber fluid. There may be a necessity at the beginning, however, to use two grades of oil, one for summer and one for winter. The transmission would provide a neutral position so that in starting the engine, any drag in the clutch would not cause trouble while warming up.

MAINTAINING TOOTH CONTACT

SEVERAL features such as the use of pitch drums to maintain correct tooth contact, embodied in an improved gear drive for railway car lighting and air conditioning purposes may suggest other ideas. Illustrated in *Fig.* 3, essential parts comprise a split gear and pitch drum mounted on a hub which in turn is placed on a standard rough-turned car axle. Gear and drum mesh and roll respectively with a suspended pinion and pitch drum unit.

Ultimate purpose of the mechanism is to drive a body-hung generator (not shown). Pushing of the pinion against the gear is done by a compression spring, the pitch drums maintaining the gear and pinion in proper mesh with each other. Face of the pinion is made wider than that of the driving gear to insure full gear tooth contact during any transverse movement of the axle in relation to the truck frame.

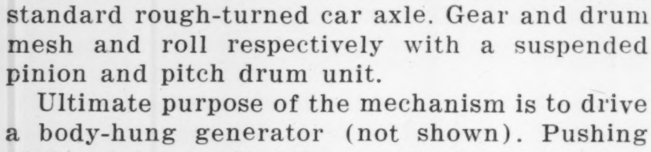


Fig. 3—Full gear tooth contact is maintained during any movements of the drive shaft of car generator transmission

A jackshaft on which the pinion, its pitch-diameter drum and a beveled transmission gear are mounted, is suspended from the truck frame at both ends, permitting the jackshaft to swing toward and from the axle. The swinging jackshaft suspension eliminates the necessity of disconnecting any part of the drive from the truck or axles when changing pairs of wheels. Gears, pinions, pitch drums and shafting are nickel steel. Foote Bros. Gear & Machine Co., Chicago, designed the unit.

AIR PRESSURE CONTROLS SIZING

AUTOMATIC sizing in connection with precision grinding operations is one of the problems that has confronted manufacturers of equipment for this type of work. It has been accomplished in a variety of ways including the use of a device based on the principle that if air is escaping from a pressure line the pressure in this line is affected by the size and shape of the outlet through which it escapes. This is the idea behind the Landis mechanism, *Fig.* 4. The change in pressure is employed to control the level of mercury in a U-tube to close contacts, constituting a mercury switch which governs the feeds and other machine movements.

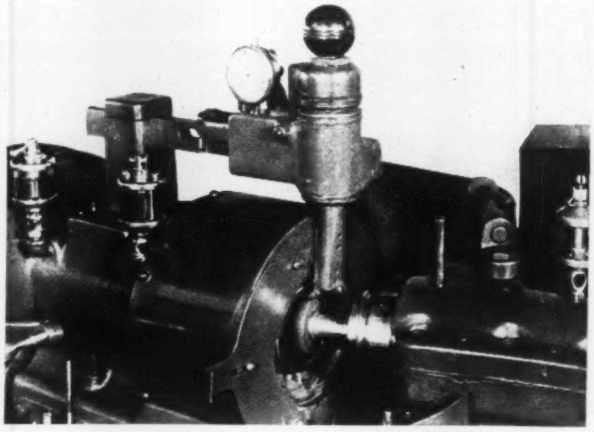


Fig. 4—Changes of pressure operating through mercury contacts controls sizing

One of the recent applications of the device is on the Landis hydraulic internal race grinder. A diamond finger rides lightly on the raceway during the entire grinding operation. It has up and down movement under spring tension. An extension at the top of the finger forms an air gap between it and the air outlet which is attached to the stationary portion of the sizing head. As the finger moves upward during grinding the size of the air gap changes. At the same time the mercury in the U-tube rises.

When the work gets down to the predetermined rough size the mercury will have risen in the tube a sufficient height to touch the longer of two contacts extending down from the top of the tube. This completes an electrical circuit, thereby energizing a solenoid which causes the grinding wheel to move away from the work. The roughing operation now is finished. After the wheel is trued the finish grinding operation starts; the mercury continues to rise in the tube until the work is down to finish size. At this point the mercury touches the short contact extending down from the top of the tube, completing a second electrical circuit. Again the wheel moves away from the work and the part is ready for removal.

MAGNETISM RECORDS SPEECH

MAGNETISM, one of the designer's most important tools, is making possible the recording of the human voice on a thin steel tape. Brief reference was made to developments along this line in the June, 1933, issue of MACHINE DESIGN. At Bell Telephone Laboratories in New York, apparatus has been designed in which the tape is passed between the poles of a pair of small electromagnets at a speed of about 1 foot per second. Speech current flowing through the windings of these magnets produces a varying magnetization in the steel tape which corresponds to the speech current.

At a distance from this recording unit may be placed a duplicate set of magnets. As the steel ribbon, already magnetized in a pattern representing the voice currents, passes between the poles of this second set it induces voice currents in their windings corresponding to the magnetic pattern and thus to the original voice currents. The result is a true reproduction of the original words spoken.

A device for eliminating the speech record from the tape is mounted beyond the second set of magnets. This enables the same piece of tape to be used over and over again. Neither the photographic nor the disk methods lend themselves readily to this continual re-recording.

FURNACE OPERATES LIKE GUN

ENGINEERS are realizing the tremendous possibilities that lie ahead in air conditioning. More evidence of this cropped out recently when an experimental unit, *Fig.* 5, designed by J. R. Edwards and Urban C. Thies, was demonstrated in the offices of the American Rolling Mill Co. at Middletown, O. This new type of equipment, operating on the blast furnace principle, will burn either coal or gas.

Burning its own gases and preheating all air entering the combustion chamber, the unit provides a temperature of 2200 degrees Fahr. in the firepot. When exhausted to the stack, the gas has a temperature of only 115 degrees. From a mechanical design standpoint the fuel supply mechanism is particularly unique. Coal, pulverized and compressed into sticks 20 inches long and 6 inches in diameter, is placed in a magazine containing six chambers. This operates automatically on the principle of a revolver cylinder.

The coal sticks feed down singly into the fire pot and burn under forced draft in the lower part of the pot. As one is consumed an electrical contact is made, causing the interior of the chamber to revolve until the next stick is positioned over the combustion chamber opening. A motor driven combustion blower circulates air in a preheat chamber, surrounding the firepot, heating it to 600-800 degrees. This air then is admitted to the burning fuel through small diagonal holes, thus starting a circular motion of flame around the coal stick.

Volatile gases, released from the upper part of the stick, are drawn off the top through a venturi tube and directed up through the grate and sphere of combustion. As the heat of combustion develops, it flows out of a throat about halfway up the fire bowl and passes into a heat exchanger. This unit is similar to two large funnels telescoped into each other inside a drum. On the outside of the funnel arrangement the downflow of house air rapidly acquires heat from its walls heated by the rising gases inside, and passes on around the hot combustion chamber back to the rooms.

The unit is adapted to cool and dehumidify the air in summer by cooling the large metal surfaces of the heat exchanger with water or mechanical refrigeration.

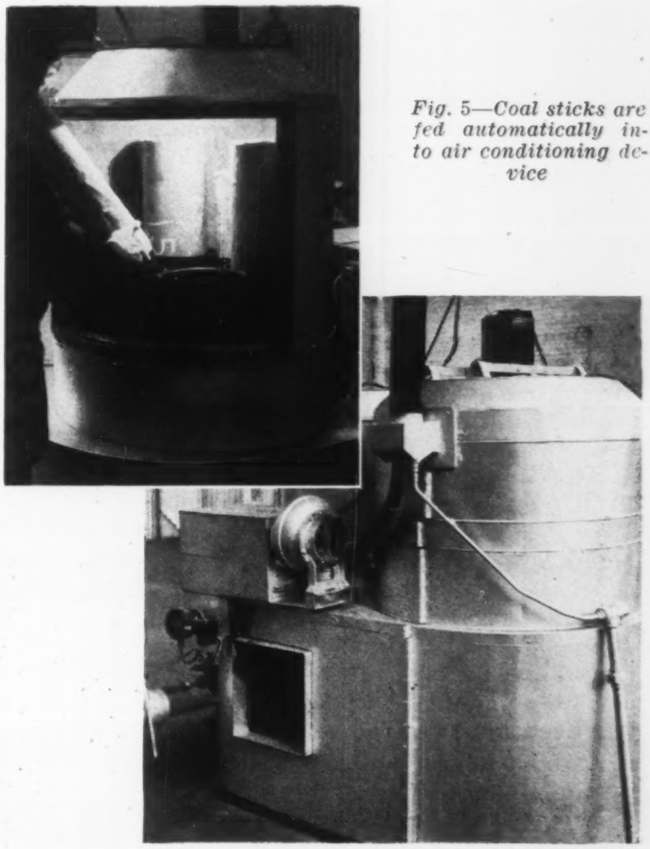


Fig. 5—Coal sticks are fed automatically into air conditioning device

Phenolic Plastics Advanc

By A. V. H. Mory

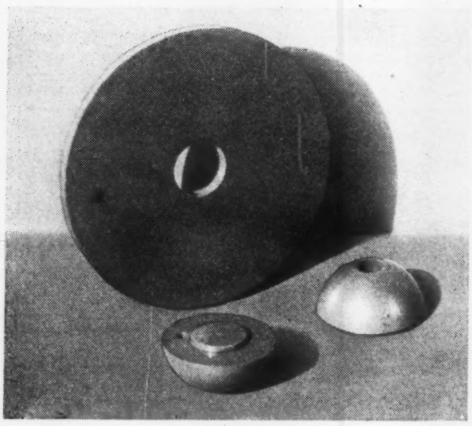


Fig. 1—Water meter disk may be molded from a composition material which is water resistant

IN HIS comprehensive article, "Plastic Materials Solve Many Problems in Design" which appeared in MACHINE DESIGN for August, 1931, A. F. Clark says in opening: "With designers striving harder than ever to improve products and reduce costs, the elimination of machining and finishing operations, reduction of noise and weight in the finished machine, and improved appearance are goals eagerly sought after."

Elimination of machining and finishing operations were early attained through the use of modern phenolic plastics. Since then have come new types of these plastic materials making possible the attainment of the other goals named.

New Materials Introduced

Reduction of noise in power transmission has been effected by the development of the phenolic laminated gear. Reduction in weight has been realized in many uses long served by metals, by the substitution of these same plastic materials reinforced or otherwise modified to suit the need. In all such uses improved appearance has been the rule and to this improvement time has provided new significance because of the enduring character of the phenolic plastics. All this was brought out in the earlier article. Since this article appeared, however, new types of materials have been developed to meet new and exacting demands, and noteworthy improvement has been made in the technique of fabrication.

Among improved materials as manufactured by the Bakelite Corp., Bound Brook, N. J., may be mentioned a molding material whose molded product has exceptional resistance to water. Water meter disks of this material, *Fig.* 1, have withstood continuous immersion in boiling water for a year with an expansion of only .005-inch per inch in direction perpendicular to that at which molding pressure was applied. A related material has a very low power factor and after exposure to a humid atmosphere suffers little deterioration in its electrical properties. Exceptional resistance to caustic alkalis is offered by the parts made of another new phenolic plastic material. After boiling for twenty-four hours in five per cent caustic soda solution such parts show only a slight dimming of luster and no softening. Another material has improved heat resistance. Ash trays molded of this material do not blister in use. Colored molding materials are much improved in brightness of hue and rapidity of molding. A highly lustrous finish may be imparted to woodflour material with all-resin surfacing material. Such a finish was obtained on the molded top plate for a noiseless typewriter, *Fig.* 2.

Materials whose molded products have a degree of flexibility that makes them suitable as a

Fig. 2—Woodflour composition with all-resin surfacing material will give a high lustrous finish

Design Reaps Benefit

coating on metal, to which they adhere firmly with the expansion and contraction of changing temperature, have been experiencing wide acceptance. A somewhat similar material provides molded insulation of an exceptionally high electric resistivity which decreases less with rise of temperature than in the case of regular materials. The dielectric strength and arc-resistance also are improved, all of which has led to the use of this type of material in airplane ignition parts and in parts of other automotive vehicles whose ignition systems are exposed to the heat of the motor.

Materials of exceptional interest to the machine designer are the recently introduced "high-impact" materials. This group includes not only those of highest impact strength but a series of materials which bridge the gap heretofore existing between the woodflour-filled materials and the high-impact materials, which are from ten to twenty times as resistant to shock. These in-between materials have led to applications heretofore not feasible since high resistance to shock is ordinarily had at the expense of ease of molding.

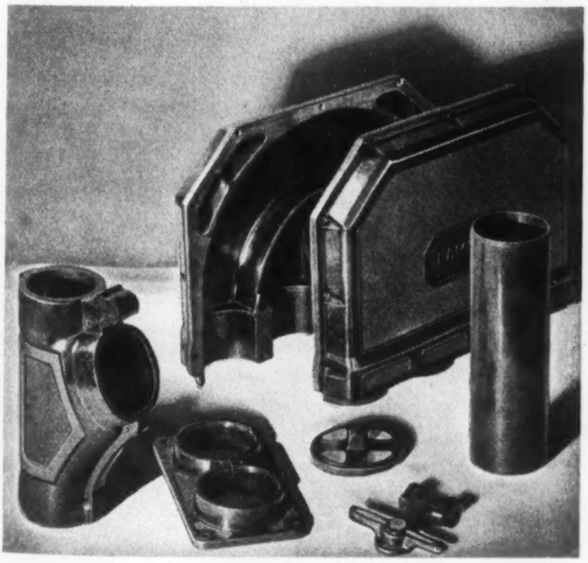


Fig. 3—Three distinctive types of finish may be obtained in a single molding operation

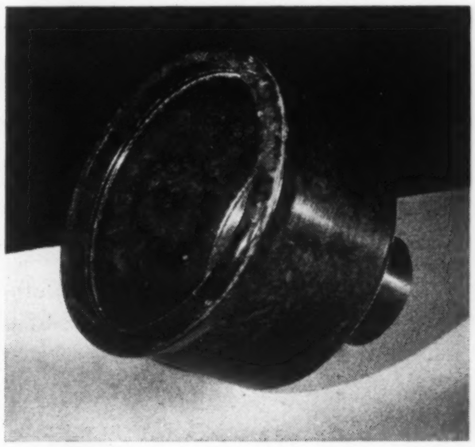


Fig. 4—Phenolic plastics which have high resistance to impact are especially useful for machine parts

And so it is that a new material whose molded products have an impact strength of 5-6 foot pounds per square inch (about double that of the regular woodflour-filled materials) is finding use in place of machined laminated parts which cost more and, for certain uses, are needlessly strong. A material characterized by impact strength of 11-13 foot pounds per square inch is finding use in molded commutators for small motors. In addition, there are materials whose impact strength are about 9 to 11, and 18 to 20, respectively. These, as well as the material of highest impact strength (25-30), are finding their special fields of usefulness. *Fig.* 4 shows a rayon spinning bucket produced in Bakelite impact materials having great resistance to shock.

New Laminated Products Noted

Until a few years ago impact strengths as high as those of these "high-impact" materials was had only through the use of the laminated products. Speaking of the laminated products, there have been new materials developed in this field also. Among these may be mentioned: Odorless breaker strips for refrigerators, which are pressed from pulp board bearing phenolic resins which have been introduced into the heater preparatory to laying down the board; materials consisting of alternate layers of laminated phenolic plastics and of rubber, for uses calling for a high resiliency; phenolic laminated materials bearing a top sheet of urea plastic for its superior, enduring, light color effects; and phenolic laminated into which are pressed colored and other metal inlays for their decorative effects.

In the matter of decorative effects there are the newer casting phenolic resinoids which are far superior to the time-honored amber variety well known for its use in smokers' articles. The newer types are available in a wide variety of colors, ranging from white and delicate hues to the most brilliant. Translucency adds softness to the color effects produced. These casting resins must be machined from cast forms which may approximate the contour of the finished articles. Where a dash of color is desired, they are finding favor as a material not only for notions but for the handles and other useful parts of objects of utility.

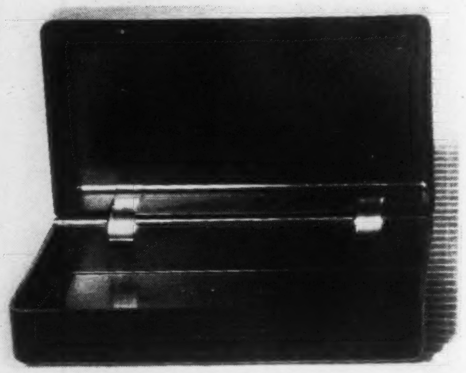


Fig. 5—Springs replace the usual hinge and catch in new device

In addition to colors, advances have been made in the finishes obtainable in the woodflour materials. As can be seen in *Fig.* 3, a group of molded parts used in a cash carrier system, three distinctive types of finishes can be obtained in one molding operation, namely: High gloss, satin and matte.

Fabrication Processes Improved

Not only in the character of these plastic materials but in the technique of their fabrication have advances been made. Through improved design and further improvement in the materials themselves the molding cycle has been shortened. Release of molded parts such as closures having beveled threads is now effected by springing them from the molds while hot. This is a patented process. Extrusion molding is being practiced with the phenolic plastics, with particular advantage in the case of the high-impact materials which, by this method, may be made to assume intricate forms not otherwise obtainable. This is also a patented process.

Sanded effects are now produced by ash buffing or sandblasting the molds themselves. A new device making for convenience and simplicity is the hidden hinge that can be built into molded boxes in which, by special design, a spring replaces both the usual hinge and catch, *Fig.* 5.

In machine design we have progressed since the day when the machine merely had a box of indifferent form built around it. Likewise have our ideas of what constitutes beauty changed not a little. It is perhaps all traceable to the speed which characterizes our age—not only speed of travel and its streamlined economy, but speed in production, which precludes unnecessary detail in design. Thus it has come about that beauty of line is supplanting beauty of detail, a product of the day of handicraft.

In addition, modern materials, by their superior characteristics, are providing new opportunities for beauty, as well as utility in design. Basically, it is new and better materials, products of scientific research, that are making possible the present-day achievements of the engineer, architect and designer, none of whom can ever rise above his available materials of construction.

Articles on this and related subjects presented in previous issues of MACHINE DESIGN include:

"Proposes Unconventional Tooth Form for Non-Metallic Gears," June, 1930, p. 45.

"Plastic Materials Solve Many Problems in Design," by Allen F. Clark, August, 1931, p. 35.

"Synthetic Materials Replace Metal," June, 1932, p. 17.

Polished Surfaces Are Liquid

OF INTEREST to engineers generally is a discovery that may lead to a new method of metallic plating. It concerns the findings of Prof. G. I. Finch and two young research students of London in establishing evidence that the surface of polished metal is liquid. According to *Science Service* which reported the event, the professor and his colleagues were working with an electron-diffraction camera, a new instrument in which a stream of electrons throws an image on a fluorescent screen, magnifying the object 30,000,000,000 times.

The London scientists experimented with a piece of polished copper which was bombarded with particles of zinc emitted from a zinc wire rapidly heated in a vacuum by an electric current. When a diffraction pattern was shown on the fluorescent screen, to their surprise the pattern gradually weakened and within three seconds disappeared entirely. They repeated the experiment four times and obtained the same results.

According to Prof. Finch the incoming crystals of zinc were dissolved in the liquid layer of the polished copper. He has found that the films of zinc or other substances thus deposited on polished metal can never be removed completely without removing the metal itself. An alloy has been formed. This process which he terms "vacuum plating" has, he believes, commercial possibilities as a substitute for electro-plating.

Determining Efficiency of Differential Screws

By A. R. Kligman

IT IS frequently found that the use of a nut with coarse pitch threads chased both on the outside and the inside and engaging on the outside a stationary bushing and, on the inside, an axially loaded screw, will enable a stronger, more efficient screw-propelling mechanism. Yet few designers are sufficiently familiar with the methods of determining the efficiencies of such devices to permit their general application.

When the two threads are of the same hand, one of lead L and the other of lead l, the mechanism is called a differential screw due to the fact that movement of the screw is the same as that of a single screw with a lead $\lambda = L - l$. This enables designers to produce as fine a movement as desirable by means of a coarsely threaded substantial screw and nut. Example: So-called telescoping screws used on some types of machine tools.

Quick Axial Movement Imparted

If, on the other hand, the two threads on the moving nut are of opposite hand, the mechanism is called a compound screw as the resulting movement of the screw is the same as that of a single screw with lead $\lambda = L + l$. A compound screw is used when quick axial movement must be imparted to the central screw, and an ordinary screw with a nut would be impractical due to the excessive lead and helix angle required or other considerations.

TABLE I

Proper Force Components and Their Moments

Acting force	Projection on axis	Projection on plane perpendicular to axis	Distance from axis	Moment of acting force
P	0	$-P$	a	$-P \times a$
Series of $\triangle M$	$-\triangle M \times \cos \alpha$	$\triangle M \times \sin \alpha$	R	$R \times \triangle M \times \cos \alpha$
Series of $\triangle N$	$\triangle N \times \cos \beta$	$-\triangle N \times \sin \beta$	r	$-r \times \triangle N \times \sin \beta$
Series of $f \times \triangle M$	$f \times \triangle M \times \sin \alpha$	$f \times \triangle M \times \cos \alpha$	R	$R \times f \times \triangle M \times \cos \alpha$
Series of $g \times \triangle N$	$g \times \triangle N \times \sin \beta$	$g \times \triangle N \times \cos \beta$	r	$r \times g \times \triangle N \times \cos \beta$

Only square threads will be considered in the following analysis.

A diagrammatic view of a differential screw is shown in *Fig*. 1. In it:

A = stationary bushing
B = propelling nut with force P acting on it through arm C of length a
D = the screw loaded axially with W and prevented from rotation by means of an arm E made fast to it and sliding in groove F parallel to axis of the screw
Q = reaction of groove F on E, acting through radius b
R = mean radius of outside thread on pair AB
r = mean radius of inside thread on pair BD
L = lead of thread in pair AB
α = helix angle for pair AB: $\alpha = \tan^{-1}(L/2\pi R)$
l = lead of thread in pair BD
β = helix angle for pair BD: $\beta = \tan^{-1}(l/2\pi r)$
f = friction coefficient for pair AB
θ = friction angle corresponding to pair AB: $\theta = \tan^{-1} f$
g = friction coefficient for pair BD
δ = friction angle corresponding to pair BD: $\delta = \tan^{-1} g$

The problem is to find, first, the ratio between the torque Pa applied to the nut B and the load W on the screw for the actual mechanism, and second, the ratio between the torque and load in an "ideal" mechanism, i.e., one which is free from friction. The relative values of these ratios determine the measure of efficiency of the mechanism.

Let us consider the system at the moment of impending movement when frictional forces along sliding surfaces are known functions of reactions normal to the sliding surfaces.

Isolating nut B first, we see that it is subjected to:

Force P at right angles to the axis of the screw
A series of normal reactions $\triangle M$ on the outside thread elements of B, each directed at an angle α to the axis and away from it a distance R
A series of normal reactions $\triangle N$ on the inside thread elements of B, each directed an angle β to the axis and away from it a distance r
A series of frictional reactions along the outside thread elements, each equal to $f \times$

$\triangle M$, if referred to the same element as $\triangle M$

A series of frictional reactions along the inside thread elements, each equal to $g \times \triangle N$, if referred to the same elements as $\triangle N$

It will be noted that normal reactions $\triangle M$ and $\triangle N$ have correct directions for the assumed direction of W. Similarly, frictional reactions $f \times \triangle M$ and $g \times \triangle N$ are correctly directed for the assumed direction of P. If P acts upon B counterclockwise as in *Fig.* 1, $f \times \triangle M$ and $g \times \triangle N$ act clockwise and vice versa.

We can write two conditions of equilibrium of the nut B:

Sum total of all forces projected on screw axis = 0

Sum total of moments about screw axis = 0

Taking the direction of W as that of the screw axis, we can tabulate proper force components and their moments as in Table I.

The equations for differential screws are then

$$-\Sigma(\triangle M \times \cos\alpha) + \Sigma(\triangle N \times \cos\beta) + \Sigma(f \times \triangle M \times \sin\alpha) + \Sigma(g \times \triangle N \times \sin\beta) = 0$$

$$-P \times a + \Sigma(R \times \triangle M \times \cos\alpha) - \Sigma\ (r \times \triangle N \times \sin\beta) + \Sigma(R \times f \times \triangle M \times \sin\alpha) + \Sigma(r \times g \times \triangle N \times \sin\beta) = 0$$

or, after simplification,

$$(\cos\alpha - f \times \sin\alpha) \times \Sigma\triangle M = (\cos\beta + g \times \sin\beta) \times \Sigma\triangle N \quad (1)$$

$$P \times a = R \times (\sin\alpha + f \times \cos\alpha) \times \Sigma\triangle M - r \times (\sin\beta - g \times \cos\beta) \times \Sigma\triangle N \quad \text{.......} (2)$$

Expressing $\Sigma\triangle M$ in terms of $\Sigma\triangle N$ through equation (1) and substituting it in (2) we get

$$P \times a = \left[\frac{R \times (\sin\alpha + f \times \cos\alpha)(\cos\beta + g \times \sin\beta)}{\cos\alpha - f \times \sin\alpha} - r(\sin\beta - g \times \cos\beta)\right] \times \Sigma\triangle N \quad \text{.......} (3)$$

Next we write the equilibrium equations for screw D, Fig. 1. The tabulation of forces, components and moments for it are given in Table II

These equations are

$$W - \Sigma(\triangle N \times \cos\beta) - \Sigma(g \times \triangle N \times \sin\beta) = 0$$

$$Q \times b + \Sigma(r \times \triangle N \times \sin\beta) - \Sigma(r \times g \times \triangle N \times \cos\beta) = 0$$

or, after simplification,

$$W = (\cos\beta + g \times \sin\beta) \times \Sigma\triangle N \quad \text{.......} (4)$$

$$Q \times b = r \times (g \times \cos\beta - \sin\beta) \times \Sigma\triangle N \quad \text{.......} (5)$$

Dividing equation (3) by (4) we get

$$\frac{P \times a}{W} = R \times \frac{\sin\alpha + f \times \cos\alpha}{\cos\alpha - f \times \sin\alpha} - r \times \frac{\sin\beta - g \times \cos\beta}{\cos\beta + g \times \sin\beta} \quad \text{....} (6)$$

Substituting $f = \tan\theta$ and $g = \tan\delta$ we can simplify and get:

$$\frac{P \times a}{W} = R \times \tan(\alpha + \theta) - r \times \tan(\beta - \delta) \quad \text{.......} (7)$$

Equation (7) establishes the relation between applied torque and load on the screw in an actual mechanism. Equating θ to δ to zero, we get the relation between torque and load for a frictionless "ideal" mechanism:

$$\frac{P' \times a}{W} = R \times \tan\alpha - r \times \tan\beta \quad \text{.......} (8)$$

Dividing (8) by (7), we get for efficiency of differential screw

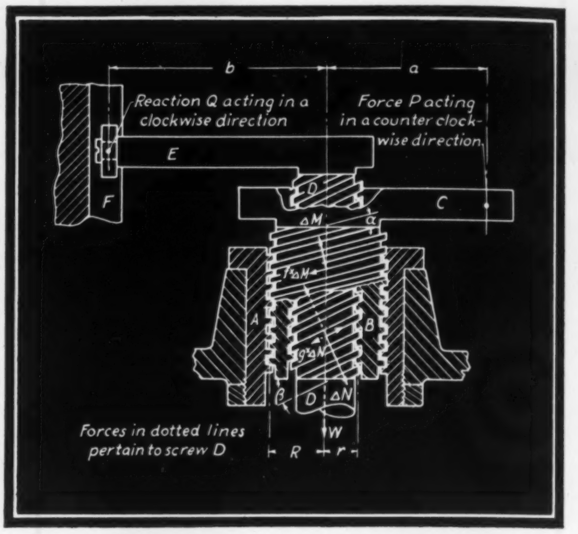
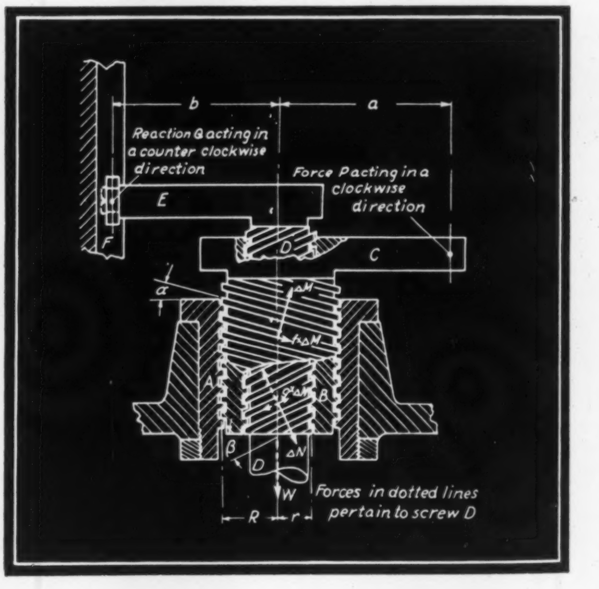

b
a
Reaction Q acting in a clockwise direction
Force P acting in a counter clockwise direction
E
F
D
C
ΔM
α
f×ΔM
A
B
g×ΔN
β
D
ΔN
W
Forces in dotted lines pertain to screw D
R
r

Fig. 1—Differential screws give fine movements with coarse threads

Fig. 2—Compound screws permit quick axial movement with ordinary lead


b
a
Reaction Q acting in a counter clockwise direction
Force P acting in a clockwise direction
E
F
D
C
α
ΔM
f×ΔM
A
g×ΔN
B
β
D
ΔN
W
Forces in dotted lines pertain to screw D
R
r

$$e = \frac{R \times \tan\alpha - r \times \tan\beta}{R \times \tan(\alpha + \theta) - r \times \tan(\beta - \delta)} \quad \text{.......} (9)$$

a rather compact formula permitting simple computation.

Incidentally, equation (5) when combined with (4) enables us to find pressure Q on the guide during the operation of the mechanism.

$$Q = Wr \times \tan(\theta - \beta) / b$$

If an identical method is used in the case of a compound screw, with regard to directions of acting forces (load and operating effort) and

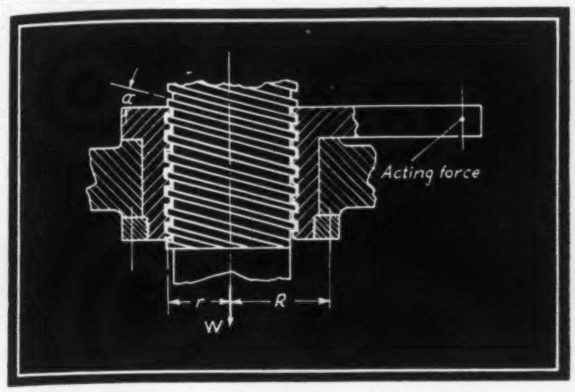


Fig. 3—Efficiency of jack screw and nut device can be determined readily with simplified formulas

thread elements reactions *Fig.* 2, the following formula for its efficiency will be obtained:

$$e=\frac{R\times tan\,\alpha+r\times tan\,\beta}{R\times tan(\alpha+\theta)+r\times tan(\beta+\delta)}\quad\ldots\ldots\ldots\ldots(10)$$

In conclusion, it might be noted that a differential screw presents a unique mechanism as it permits micrometer movement by means of coarsely threaded screw members. A compound screw, on the other hand, possesses no such uniqueness as it is only an alternative to a simple screw and nut arrangement. Its usefulness is apparent, however, when quick axial movement is desired and the resulting large lead is not practical due to the necessity for too high a value of helix angle. Indeed, if the latter exceeds the friction angle the mechanism is not self-locking. Where there is no need to make the mechanism self-locking or where the helix angle of a simple screw is smaller than the friction angle, the relative merits of both arrangements can be decided upon only after a comparison of efficiencies as determined by formula (10) and by formula (11) which is given in the following.

Using the rotation for the jack screw and nut device as shown in *Fig.* 3, we have for its efficiency

$$e=\frac{r\times tan\,\alpha}{r\times tan(\alpha+\delta)+R\times tan\,\theta}\quad\ldots\ldots\ldots\ldots(11)$$

Let us consider a case where the following data are given:

Lead of outside and inside thread elements is 3 inches
Outside diameter of lifter nut B is $7\frac{15}{16}$ inches
Bore in bushing A is $7\frac{1}{8}$ inches
Outside diameter of screw D is $4\frac{15}{16}$ inches
Bore in lifter nut B is $4\frac{3}{16}$ inches
Elements A and D are of same material so that $f=g$
No lubrication is provided, and $f=g=0.2$

In this case

$R=(7\frac{15}{16}+7\frac{1}{8})\div 4=3\frac{49}{64}$ inches
$r=(4\frac{15}{16}+4\frac{3}{16})\div 4=2\frac{9}{32}$ inches
$\alpha=tan^{-1}(3/2\times 3\frac{49}{64}\pi)=7$ degrees 14 minutes
$\beta=tan^{-1}(3/2\times 2\frac{9}{32}\pi)=11$ degrees 49 minutes
$\theta=\delta=11$ degrees 19 minutes
$e=0.426$ or 42.6 per cent

On the other hand, a simple jack screw with nut proportioned so that its

$Lead=6$ inches
$R=3\frac{49}{64}$ inches
$r=2\frac{9}{32}$ inches
$f=0.2$
$\delta=\theta=11$ degrees 19 minutes

will have

$\alpha=tan^{-1}\left(\frac{6}{2\times 2\frac{9}{32}\pi}\right)=22$ dcgrees 43 minutes
$e=0.416$ or 41.6 per cent

In this case there is only an insignificant mechanical advantage to be obtained by using a compound screw instead of a simple screw and nut, and considerations other than that of efficiency should govern the selection of the mechanism.

Articles on this and allied subjects published in previous issues of Machine Design include:
"Stress in Riveted and Screwed Fastenings," by John V. Martenis, Nov., 1929, p. 13.
"Designing Bolts for Shock Loads," by J. I. Clower, Sept., 1931, p. 36, also by E. S. Ault, Oct., 1931, p. 53.
"Timesavers Aid Busy Designers," by Karl A. Eckhardt, Oct., 1931, p. 53.
"Machine Fastenings May Spell Failure or Success," by Harold B. Veith, July, 1932, p. 32.
"Avoiding Fine Screw Systems," March, 1934, p. 21.

TABLE II

Tabulation of Forces, Components and Moments

Acting force	Projection on axis	Projection on plane perpendicular to axis	Distance from axis	Moment of acting force
W	W	0	0	0
Q	0	Q	b	$Q\times b$
Series of $\triangle N$	$-\triangle N\times cos\,\beta$	$\triangle N\times sin\,\beta$	r	$r\times\triangle N\times sin\,\beta$
Series of $g\times\triangle N$	$-g\times\triangle N\times sin\,\beta$	$-g\times\triangle N\times cos\,\beta$	r	$-r\times g\times\triangle N\times cos\,\beta$

Coaxing Metal Strength

METALS such as hot-rolled pig iron and brittle cast iron may be coaxed into greater strength by applying gradually increasing stresses to them while they are being rotated, experiments recently conducted by J. B. Kommers, professor of mechanics at University of Wisconsin, Madison, Wis., have revealed. The strength of hot-rolled iron may be increased as much as 24 per cent, while that of brittle cast iron may be increased by one-third Professor Kommers has shown. His experiments also show that even notched specimens of metal, usually considered much weaker because of the notch, may be coaxed into greater strengths by application of slowly increasing stresses while rotating.

Coaxing metals into greater resistance to fatigue, that is, resistance to breaking down, has been recognized by engineers for several years, but has been shown to be much more important than was originally supposed. In earlier experiments metals were subjected to a constant stress slightly less than their original endurance limits. Understressed in this manner, the endurance limit gradually increases.

Invention—A Scientific Phenomenon

Radiography, Heating and Ventilating Covered in New Books

The Inventor and His World

By H. Stafford Hatfield; published by E. P. Dutton & Co., New York; available through MACHINE DESIGN *for* $2.40 *plus* 15 *cents postage.*

Inventors are mechanical geniuses who are doubly interesting because of their foibles and idiosyncrasies. The author, who is a scientist and inventor, tells the story of invention from a practical and philosophic point of view. He indicates the characteristic temperament of the inventor, shows how he works, and explains why it is so difficult for the inventor to get his invention adopted.

The inventor, to be successful, needs to combine in himself a great many diverse qualities. In the first place, he must be in love with invention, and either have faith in its value, or at least an abiding delight in it as a game. He must have an instinctive grasp of the fundamentals of the field in which he works, and, on top of that, a sound scientific education, at least for many types of work. For others, the *sine qua non* is a thorough practical experience. And quite apart from these qualities, and by no means usually associated with them, he needs a sound capacity for objective consideration of all the industrial pros and cons of a given problem and its possible solutions. If he possesses all these qualities, he will certainly never want for funds to live modestly and experiment to a restricted degree.

Mechanical, chemical, electrical, biological, and physchological inventions are treated fully, and the book contains a valuable chapter on the patent law in the United States, Great Britain and Germany. The book not only shows the inventor the best way to proceed, but it points out to the man who is interested in financing the invention the best way to handle the inventor and the invention itself.

□ □ □

Industrial Radiography

By Ancel St. John and Herbert R. Isenburger; published by John Wiley & Sons Inc., New York; available through MACHINE DESIGN *for* $3.50 *plus* 15 *cents postage.*

Industrial radiography applies radiant energy to nondestructive testing. Herein lies its importance, for when applicable it is able to assure the designer that the object examined is sound and satisfactory, or to supply evidence as to the location and extent of any necessary reconditioning. Moreover, when properly made, the original record presents its proof of authenticity as well as the evidence concerning the material. It thus carries conviction to the user. The range and usefulness of industrial radiography will be extended as more designers and more users realize its possibilities.

In this book, the infancy and early years of radiography are presented, followed by its present status. The nature and properties of X-rays are discussed, with observations on the interrelation of matter and the rays. Production of the rays, their detection and recording are also discussed. The book then takes up the practical side, installation, procedure in making a radiograph and interpretation of the result.

□ □ □

1934 A.S.H.V.E. Guide

Twelfth edition; published by the American Society of Heating and Ventilating Engineers; available through MACHINE DESIGN *for* $5.00 *plus* 15 *cents postage.*

This year's Guide marks another achievement in bringing to the engineering profession up-to-date data on the many phases covered by the ever-widening heating and ventilating field. Particularly noteworthy are the extensive changes that have been made in chapters covering industrial air conditioning, natural ventilation, central fan systems, radiators and gravity convectors, heating boilers, pipe insulation, fittings and welding, etc.

With 42 chapters and a comprehensive index to the text occupying 618 pages, the 1934 edition presents the largest technical data section ever compiled and published by the society. From the practical experience of members as well as from different research sources authoritative facts have been prepared for the various classes of engineers engaged in designing, operating, specifying or installing systems and apparatus.

□ □ □

A revised and enlarged edition of the *"Procedure Handbook of Arc Welding Design and Practice,"* is announced by the publishers, Lincoln Electric Co. The volume has been reissued because of the demand which exhausted the original issue, reviewed on page 41, Oct., 1933, MACHINE DESIGN.

Patent Contracts Insure Legal Protection

By George V. Woodling

INDUSTRY, in large measure, is based upon the laws governing the rights between the employer and the employe. Of these laws, those relating to patents and inventions have played a major part toward the rapid growth of our industrial life. There is every reason to believe that, with the New Deal, industry may look forward to a continuation of, or possibly an acceleration in, the march of progress of inventions. With the abandonment of unfair methods of competition and the elimination of many trade abuses such as selling below cost and the dumping of goods, there may rise a new form of competition based upon ingenuity and inventive skill, employed to produce a grade of merchandise superior to that heretofore offered.

Notwithstanding the fact that the law is quite clear regarding inventions, as between employer and employe, a great deal of difficulty resides in applying the law to the complex and involved set of facts about which a disputed question of invention or patents usually arises. This difficulty probably accounts for the numerous employer-employe cases that have been brought before the courts. In such cases the circumstances that exist between the employer and employe usually involve two major questions.

Who Conceived the Invention?

First, there is the question of *originality,* that is, who conceived the invention, the employer or the employe? And second there is the question of *ownership,* that is, who has title to the invention, the employer or employe? Originality and ownership touch upon two separate and independent questions of law and thus should not be confused with each other.

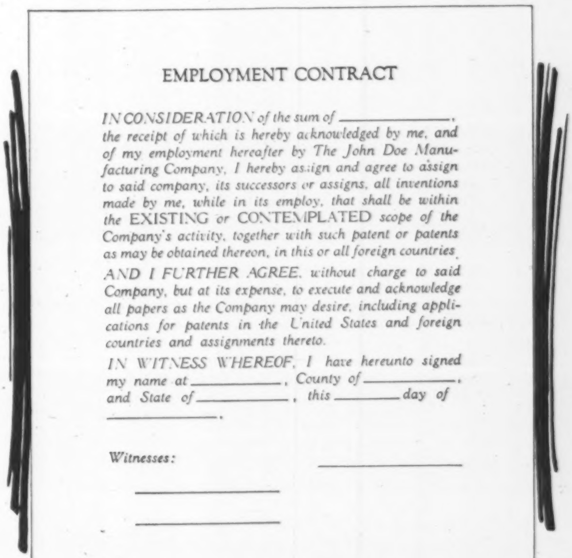
The question of originality frequently arises where an employer has an idea and directs an employe to develop this idea for him. Not infrequently both the employer and the employe claim to be the inventor; that is, the originator. When the contradictory evidence seems evenly balanced, the case can best be decided by awarding the inventorship to the one who appears most likely to be capable of making the invention. If both appear to be equally capable, the courts generally lean toward the employer. In deciding such disputes, any one of three decisions may result. The employer may be considered to be the *sole* inventor; the employe may be considered to be the *sole* inventor; or they may be considered to be *joint* inventors.

In all cases where a doubt exists as to who is the real inventor, the whole story should be related, as soon as possible while the facts are fresh, to the disputants' patent attorney. It is highly important that a correct decision be made before filing a patent application because a patent application, in order that it may mature into a valid patent, must be filed in the name of the true inventor. Thus, the improper yielding of the employe to the employer, or vice versa, or either demanding more than is justifiable, may result in an invalid patent.

May Invalidate Patent

Accordingly, a patent for a joint invention which issues on an application filed in the name of a sole inventor is invalid and, conversely, a patent for a sole invention which issues on an application filed in the name of joint inventors is also invalid.

It has been held that in order to constitute



EMPLOYMENT CONTRACT

IN CONSIDERATION of the sum of ________, the receipt of which is hereby acknowledged by me, and of my employment hereafter by The John Doe Manufacturing Company, I hereby assign and agree to assign to said company, its successors or assigns, all inventions made by me, while in its employ, that shall be within the EXISTING *or* CONTEMPLATED *scope of the Company's activity, together with such patent or patents as may be obtained thereon, in this or all foreign countries.*

AND I FURTHER AGREE, without charge to said Company, but at its expense, to execute and acknowledge all papers as the Company may desire, including applications for patents in the United States and foreign countries and assignments thereto.

IN WITNESS WHEREOF, I have hereunto signed my name at ________, County of ________, and State of ________, this ________ day of ________.

Witnesses: ________

____

____

Fig. 1—Patent contracts should cover as many possible situations as is practicable

Copyright, 1934, *by George V. Woodling*

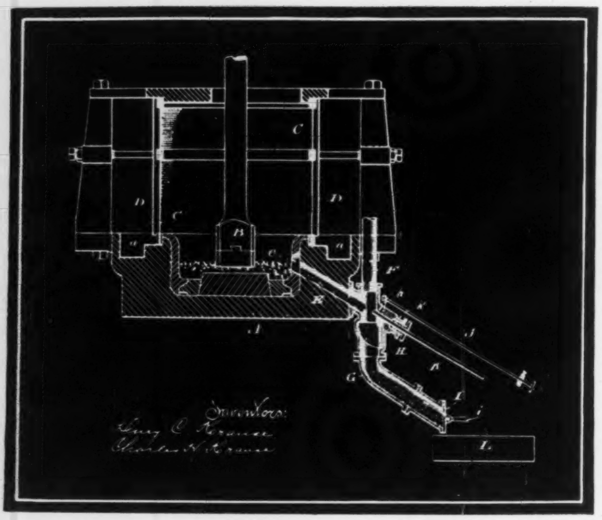


Fig. 2—When a single idea only is covered, a patent in the name of joint inventors is invalid

joint invention it is necessary that the employer and employe produce the invention by their joint efforts. This statement, however, does not help very much because now the query is, what constitutes joint effort? In this connection, decisions hold that where a person has a preconceived idea of an invention and the other person merely makes a valuable suggestion regarding the idea, there is not sufficient joint effort between them growing out of the suggestion alone to make them joint inventors. However, where the suggestions are more than mere suggestions as to the form of the invention and particularly where the suggestions go to the essence of the invention and thus cause a modification of the other's idea, there is sufficient joint effort to make them joint inventors.

Assignment of Ideas Difficult

Joint effort is not negatived by reason of the fact that one of the two inventors conceived the best thought that entered into the invention. The attempt to dissect an invention produced by the mutual suggestions and to assign one inventor this and another inventor that, has been held to be a difficult and dangerous undertaking. In fact, one inventor may have conceived the entire device, but if the other makes suggestions of a practical value which assist in developing the main idea and in making it operative, or contributes an independent part which helps to create the whole, the second person is a joint inventor even though his contribution be of minor importance. However, if the inventive idea covers but a single thought, it is difficult to apprehend how two could share in the conception. Thus, the patent illustrated in *Fig.* 2, which covers but a single idea, was contested as being invalid, as it was filed in the name of joint inventors instead of the sole inventor.

The following analogy may help to clarify the question of joint inventorship. Thus, if a person has an idea which requires a great deal of technical data which he does not possess and he goes to an engineering book and obtains the necessary information, it is obvious that the writer of the book is not a joint inventor. But, if a president obtains technical information from his chief engineer instead of the engineering book, there would be, no doubt, a feeling on the part of the engineer that he is a joint inventor along with the president. As a matter of law, there is no more joint invention in the second case than in the first.

Three Situations Possible

There are three other situations that may arise between the employer and employe. First, there is the case where the employer conceives the complete and workable idea and directs the employe to work out the details. In this case the employer is the sole inventor because the work which the employe performs involves merely the exercise of mechanical skill and not the exercise of inventive faculties. Second, there is the case where the employe discards the ideas or plans of the employer and develops an invention embodying his own ideas. In this case the employe is the sole inventor, because the work which the employe performs involves planning of a new idea and thus requires the exercise of inventive faculties. Third, there is the case where the employer preconceives only the need, and directs the employe to develop a machine for accomplishing the desired results. In this case the employe is also the sole inventor because he worked out both the plans and the details.

It must not be inferred that the employer-employe relationship exists only where there is the usual conditions of employment. This relationship exists, for instance, between a shop foreman and a worker who is in a subservient relation to him; between the client and the patent attorney, or between the inventor and the machinist engaged to make a model of the invention.

Passing from the subject of the originality we will deal with the ownership of inventions,

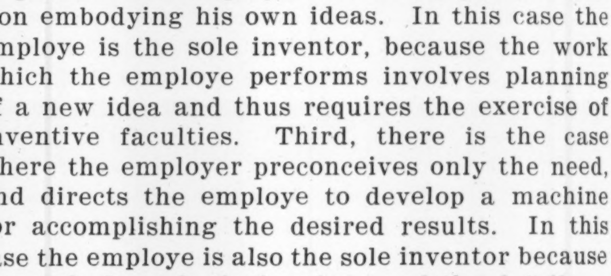


Fig. 3—Employer's materials were used to perfect invention, yet title remained with employe

as between the employer and the employe. There is no obligation on the part of the employe to assign to his employer the ownership of inventions, made in the course of his employment, arising out of the mere employment relationship of employer and employe. Ownership is determined only by contract, either expressed or implied. Thus, notwithstanding the fact that an award of inventorship may be given to the employe, yet by the terms of a contract the employe may be compelled by law to assign the invention to the employer. If there is a good written contract as to the ownership of inventions made by an employe, no difficulty is usually encountered. Such contractual provisions covering the assignment of inventions are usually made a part of the employment agreement, and are included among the conditions upon which employment is based.

Relatively Short Forms Employed

In actual practice, some companies use employment contracts that set forth in great detail the conditions surrounding the ownership of inventions made by an employe. Others use a relatively short form which simply calls for the general assignment of inventions that falls within the existing or contemplated scope of the company's activities. Such a contract is shown in *Fig.* 1. As worded, this contract is merely representative and should not be used unless its provisions best meet the intentions of the parties.

It is interesting to note that these contracts have not been free from legal attack upon the ground that they are unconscionable and thus void as against public policy in restraint of trade. This argument is based upon the proposition that under such contracts the employe-inventor tends to withhold his inventions from his employer, with the result that there is a retardation in the progress of science and inventions, all to the injury of the public. In substantially all of such suits the courts, however, seem to hold very strongly that such contracts are with public policy rather than against it.

Decisions Favor Employes

Even so, the courts interpret such contracts most strongly against the employer. Thus, if an employe invents a machine which is not covered clearly by the terms of the contract, the ownership of the invention belongs to the employe. This is true even though the employe's inventive powers were incited by knowledge necessarily derived from his employment, and even though to perfect the machine the employe used his employer's shop and tools, or received the assistance of other employes, or takes time which should have been given to his employer's business.

There are many cases that support this view, to-wit: A workman by the name of Dice entered the employment of a company that manufactured "shellers and powers." The employment contract provided, among other things, that he was to work for the best interest of the company in every way and that any *future improvements* made by him should belong to the company. A few months later, the company added to its business the manufacture of "check rowers" (an attachment to a machine for planting corn), and Dice was assigned to the superintendence of their manufacture.

While so employed he invented an improvement in "check rowers" *Fig.* 3, and in order to perfect it he used the company's materials, as well as its employes. When the invention was finished he claimed it as his own. In a suit, the court held that the company was not entitled, in equity, to have the invention as to "check rowers" transferred to it as its exclusive property, and compel the inventor to assign his right to a patent, for the reason that the words "future improvements" as set forth in the employment contract have reference only to improvements in "shellers and powers," and not to "check rowers."

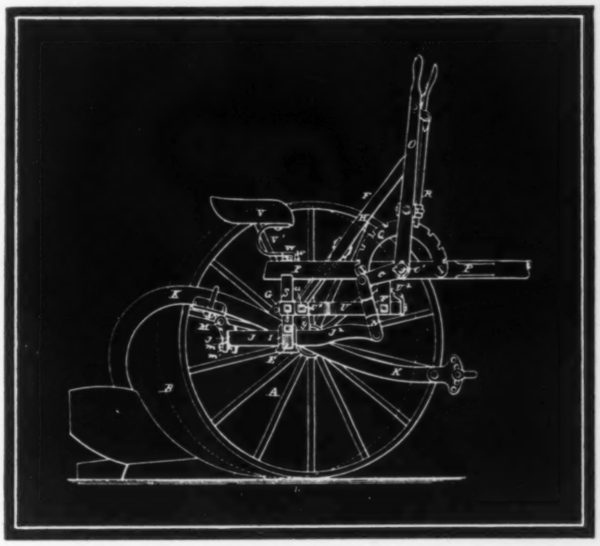


Fig. 4—Implied license in inventions extends only to machines built and used by the employer

In this regard, it is observed that under the employment contract shown in *Fig.* 1 the company would have been entitled to the exclusive property of the improvement on "check rowers," as this contract states that all inventions made by the employe within the existing or contemplated scope of the company's activities shall belong to the company. The experience growing out of the "check rowers" case, as well as of many other kindred cases, shows that if inventions are contemplated, or if there are likely to be any inventions made by an employe during the course of his employment, nothing short of a clear, definite and complete contract should be prepared and signed by both the employer and the employe.

The law relevant to the ownership of inventions, as between an employer and an employe, may be classified under three headings.

First, in the absence of an expressed contract to the contrary, ownership to inventions made by an employe outside of working hours, without the use of materials belonging to the employer, and having no bearing upon the employe's duties, *vests in the employe, with no interest whatsoever in the employer*.

Second, in the absence of an expressed contract to the contrary, ownership to inventions made by an employe, who is *specifically employed to make the invention,* vests in the employer, with no interest whatever in the employe.

Third, in the absence of an expressed contract to the contrary, ownership to inventions made by an employe arising out of, or made in connection with, the employe's duties, *which duties are not specifically that of inventing or developing invention,* and where the employer's materials are used to perfect the invention, vests in the employe, with an implied license, or "shop-right" to the employer. Thus, under this heading both the employer and the employe possess certain rights.

Implied License Clarifies Rights

The implied license which the employer receives merely gives him the right to use the invention without paying royalties to the employe. It does not give the employer the right to prosecute competitors for infringement. Accordingly, the employer has no control over the invention to prevent competition in the event that the employe should sell or license the invention to competitors. In the case of machines, for example, the implied license extends only to those machines built and used by the employer. Furthermore, an implied license is personal to the employer and thus cannot be assigned to another, but may be passed on by succession. If the employe permits the employer to sell the invention, as well as manufacture it, there is an implied license which entitles the employer both to manufacture and sell.

Contract Did Not Cover

It may not be amiss to relate the facts of an interesting case involving this question. One Hewitt was employed as factory superintendent of the plaintiff company, manufacturer of ploughs. While so employed, he invented a new plough, *Fig.* 4, and developed it by working during the regular hours of his employment and by using the company's materials and the assistance of other employes. He permitted the company to manufacture and sell the invention, and later, when he left the company, he took out a patent. In consequence, suit was brought for transfer of the ownership of the patent from Hewitt to the company. As there was nothing in the employment contract on this point, the court held that ownership remained in Hewitt, with an implied license to make and sell the invention vested in the company.

The decisions in some cases which give the em-

(*Concluded on Page* 61)

Factors Governing Originality and Ownership of Inventions

- Inventions as between employer and employe
  - Originality of invention
    - 1—Joint invention of employer and employe
      - To constitute joint invention the employer and employe must produce the invention by their joint efforts, and the joint effort must be such that the suggestions of each goes to the essence of the invention and thus causes a modification of the other's idea
    - 2—Sole invention of either the employer or the employe
      - 1—The employer is the *sole* inventor if he conceives a complete and workable idea and directs the employe to work out the details which do not involve the exercise of inventive faculties
      - 2—The employe is the *sole* inventor if he discards the ideas or plans of the employer and develops an invention embodying his own ideas
      - 3—The employe is the *sole* inventor where the employer merely perceives the need of a certain thing, and directs the employe to develop a device for accomplishing the desired result
  - Ownership of invention
    - 1—In the absence of an expressed contract to the contrary, ownership to inventions made by an employe outside of working hours, without the use of materials belonging to the employer, and having no bearing upon the employe's duties, vests in the employe, with no interest whatsoever in the employer
    - 2—In the absence of an expressed contract to the contrary, ownership to inventions made by an employe who is specifically employed to make the invention vests in the employer, with no interest whatsoever in the employe, because the employe, upon making the invention, did no more than he was specifically employed to do
    - 3—In the absence of an expressed contract to the contrary, ownership to inventions made by an employe arising out of, or made in connection with, the employe's duties, which duties are not specifically that of inventing or developing inventions, and where the employer's materials are used to perfect the invention, vests in the employe, with an implied license or "shop-right" to the employer

Combating Noise in Machinery

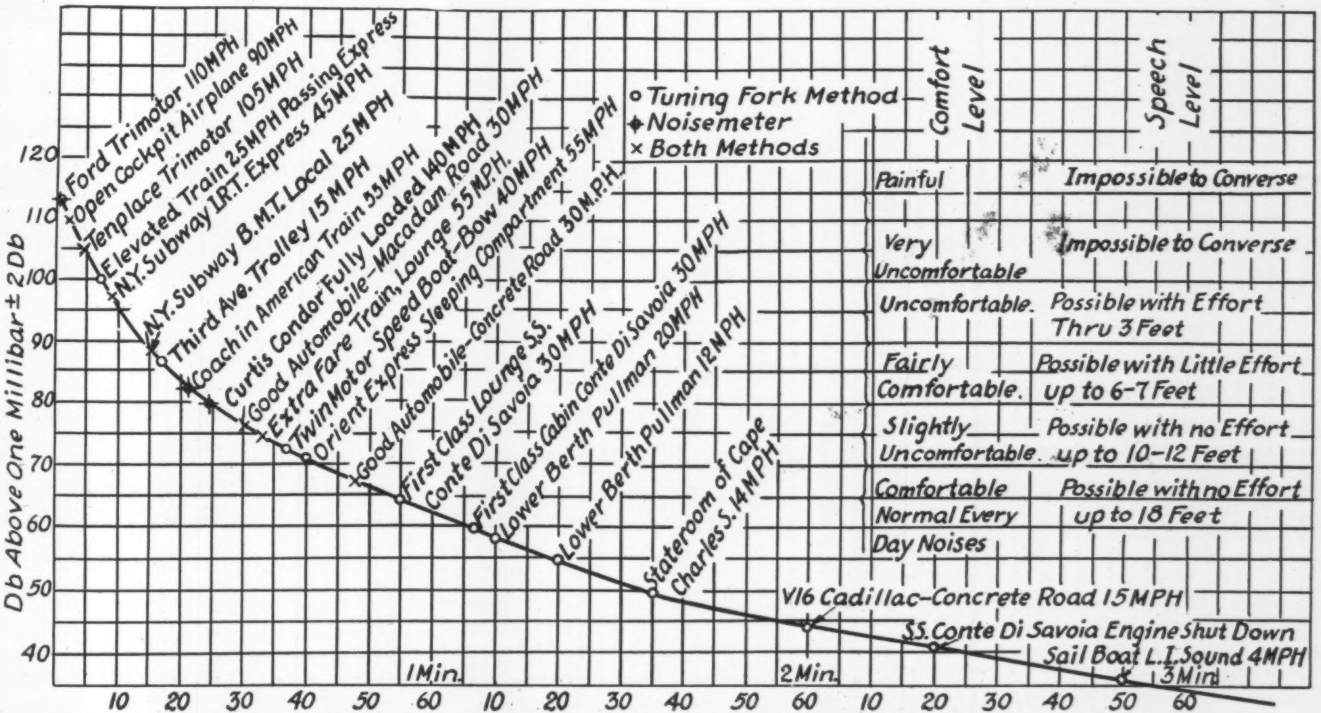
HOW do noise levels in different modes of transportation compare? With the intense interest that is developing in the reduction of noise in machinery of all kinds, a comprehensive study that has been made in this field is especially noteworthy. The compilation, as disclosed by the accompanying chart, was made by P. R. Bassett and S. J. Zand, of the Sperry Gyroscope Co. Inc., and was presented as part of their paper on "Noise Reduction in Cabin Airplanes," before the aeronautic division of the American Society of Mechanical Engineers.

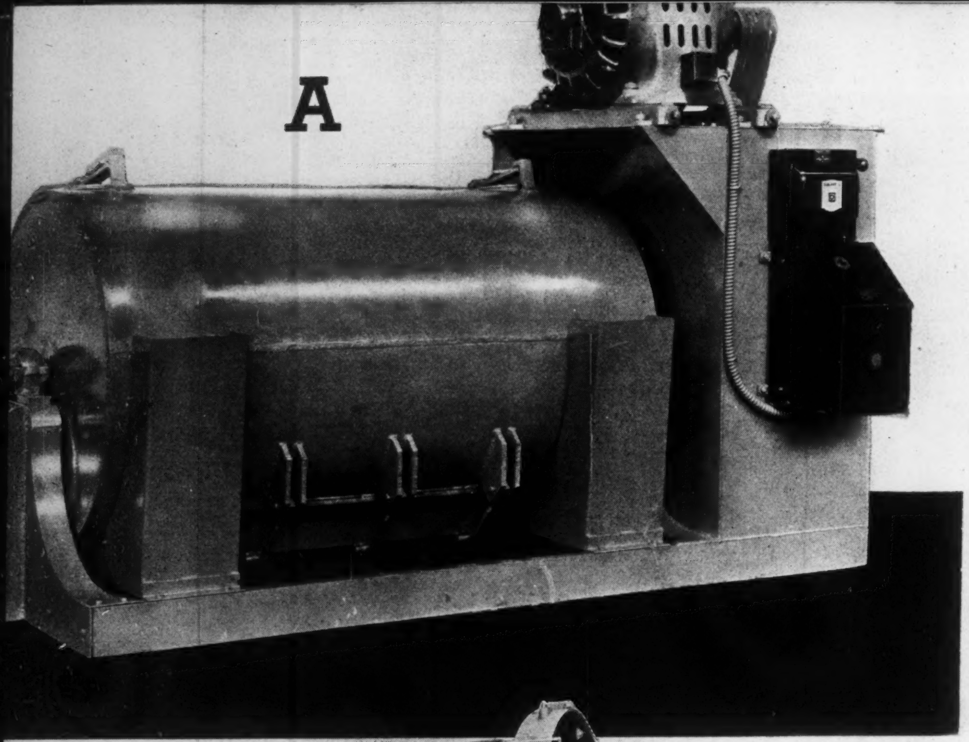
Grades of Comfort Indicated

The method of determining the various noise levels is unique; decibels as measured on a noise meter are plotted against masking time of a tuning fork. Readings include every form of transportation from sailboat to open-cockpit plane, and grades of comfort are indicated approximately at the right of the chart.

From the curve it will be noted that a Curtis Condor plane traveling at 140 miles per hour is in the region of trains and trolley cars as regards noise levels. In their paper the authors list some of the innovations incorporated in the basic design of this plane which contribute to quietness. Location of the propeller was chosen so that its plane passes between the cockpit and the cabin proper, intersecting the radio compartment. This room is separated from the cabin by a bulkhead treated with an acoustical material, and a fully gasketed door. Engines are mounted on shear type rubber shock absorbers. Windows are floating; glass is lighter and its vibration damping coefficient is ten times higher than ordinary safety glass. Therefore the windows do not "sing." Cabin framework is insulated from the main structure by means of a felt shock absorber. Asbestos gaskets are employed to insulate the clamps of the exhaust manifolds, tuned to unison.

Attention was given to all details and the result was a noise level of about 78 decibels, at cruising speed of 145 to 150 miles per hour with four passengers and no baggage. Fully loaded, the noise level dropped to about 76 decibels at 150 miles per hour or no more than in the average railroad car at 60 miles per hour.





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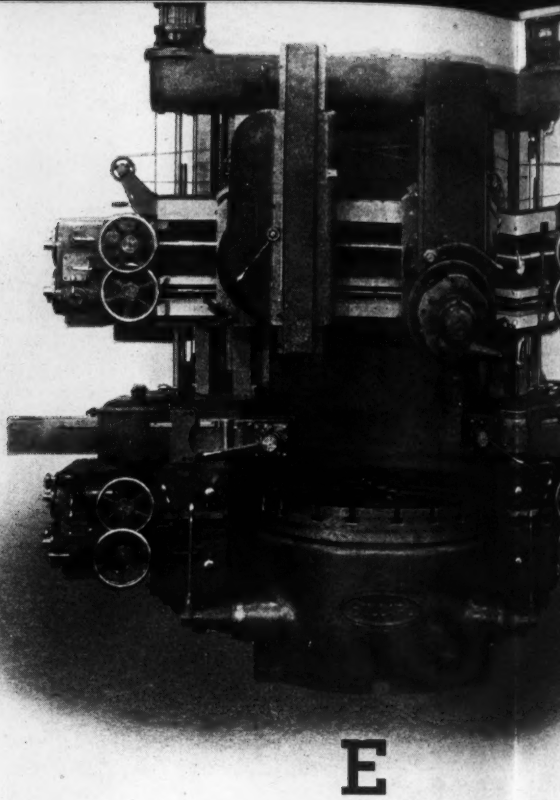

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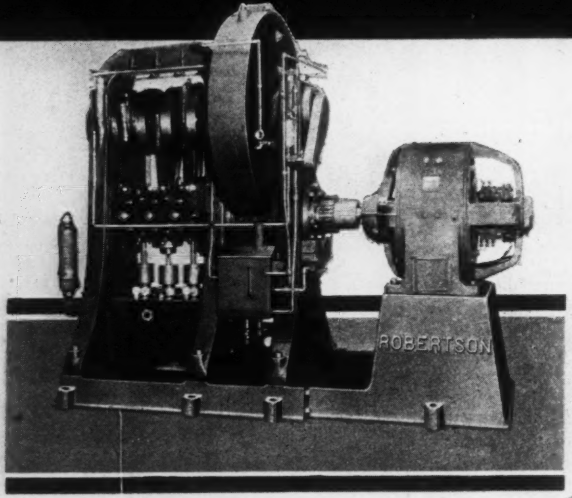

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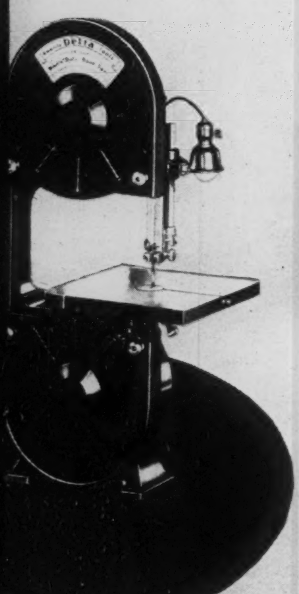

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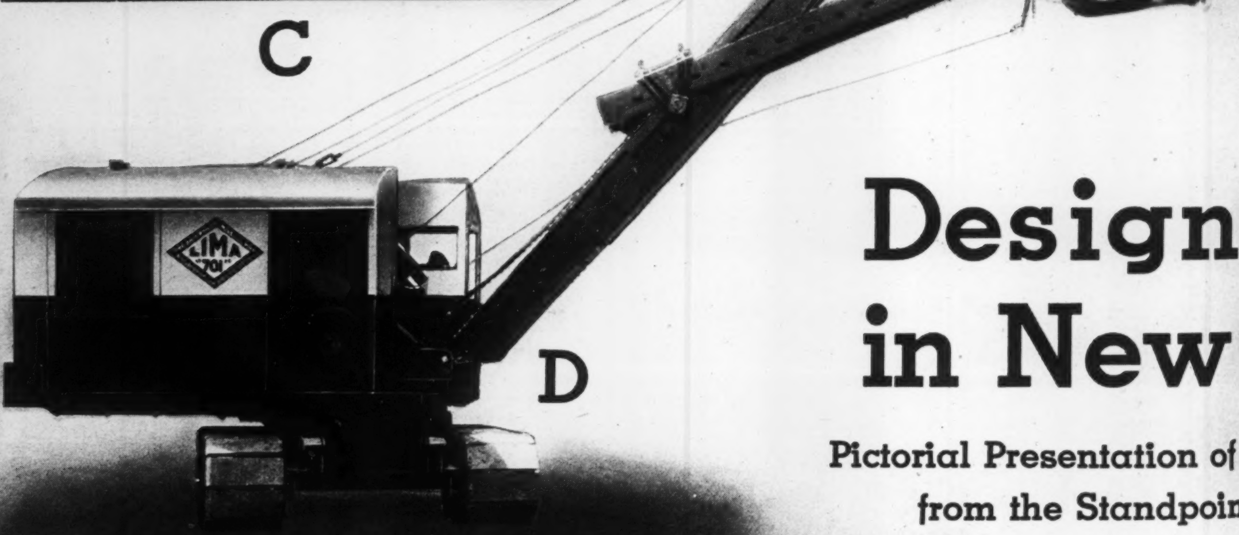


D

Design Fe
in New M

Pictorial Presentation of Recentl
from the Standpoint of Des

(A) Manual handling of cleaning materials is eliminated in this tumbling barrel. Passages of patented design automatically transfer stars to central section when drum is rotated in tumbling direction and return them to end sections when reversed. The barrel, fabricated by welding, is made by N. Ransohoff Inc.

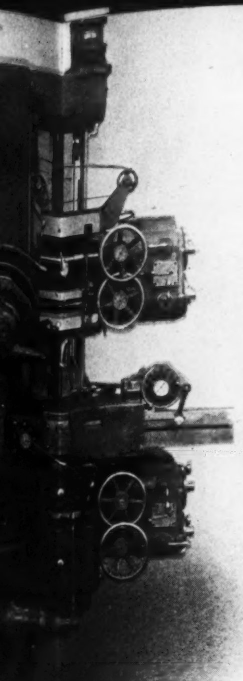
(B) Blade supports on Delta Mfg. Co. bandsaw are double-seal ball bearings, while similar bearings are used for wheel mountings. Smoother tilting action and stronger table mounting is achieved by running the saw slot to side of table, permitting the use of trunnions on each side of the blade.

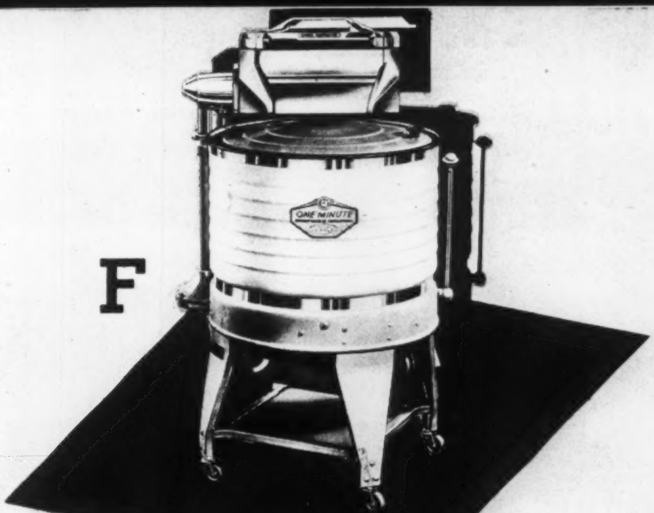
(C) Lubrication is automatic in vertical plunger hydraulic pump of John Robertson Co. Plungers of rust resisting steel are guided above and below the plunger packings by bronze guide bushings. Drive pinion is cut integral with roller bearing-mounted pinion shaft.

(D) Quieter and longer life helical type gears for important drives have been adopted by Ohio Power Shovel Co. in its new shovel. Gearcase and all supports are cast integral in one-piece steel casting used for frame. Roller bearings are employed at all vital points. Hoist clutches of special design give the operator the "feel" of the work.

(E) Vertical turret lathe by Bu
hydraulically operated spe
Trip levers permit instantaneou
Control of the individual mot
traverse and rail-raising is throu
limit switches. Pressure lubr

(F) Safety of operator and mac
top wringer bar in new
Washer Co. A slight push on the
rolls are stopped instantly. Pu
rolls into motion, locks wringer
to correct position. Synchro
floating power motors and oill





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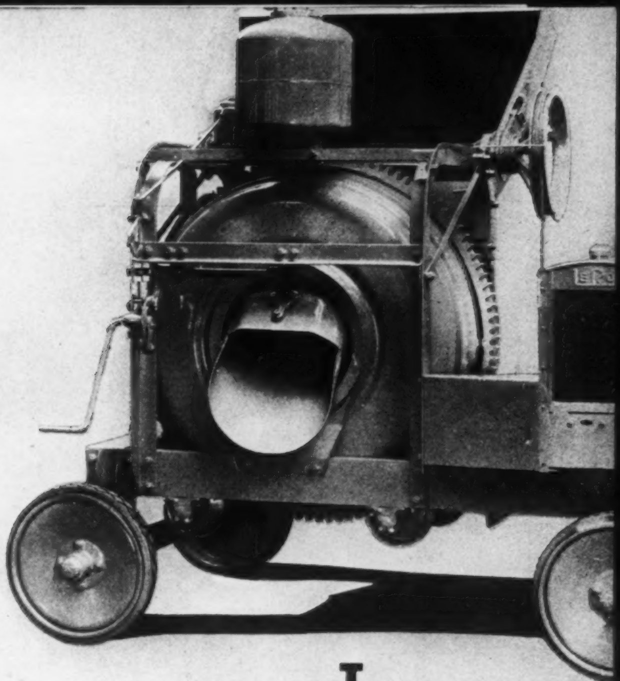

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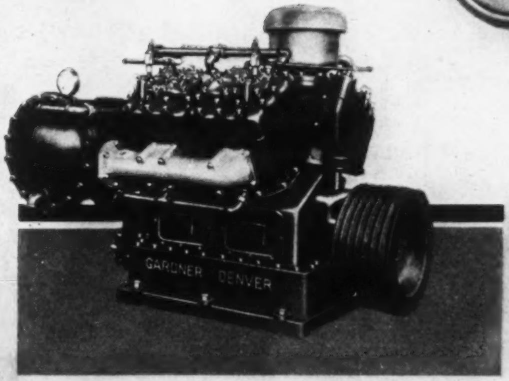

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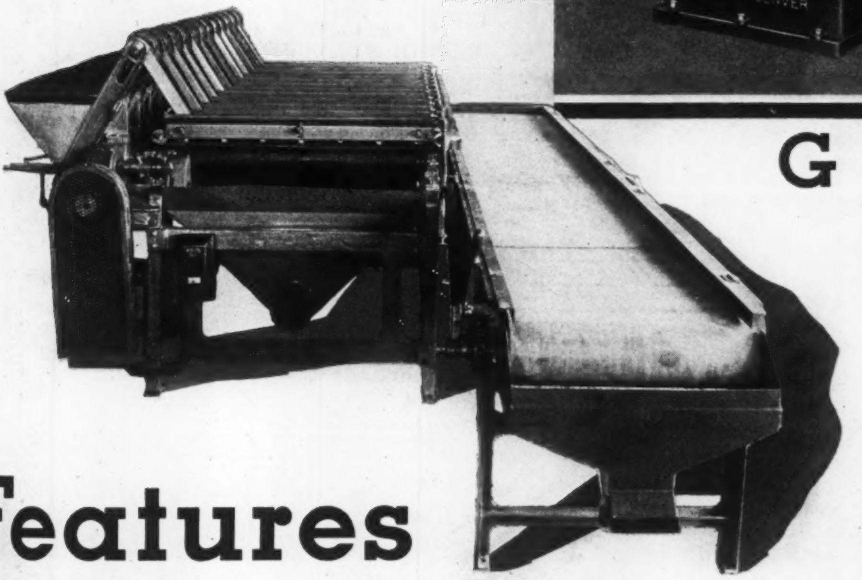

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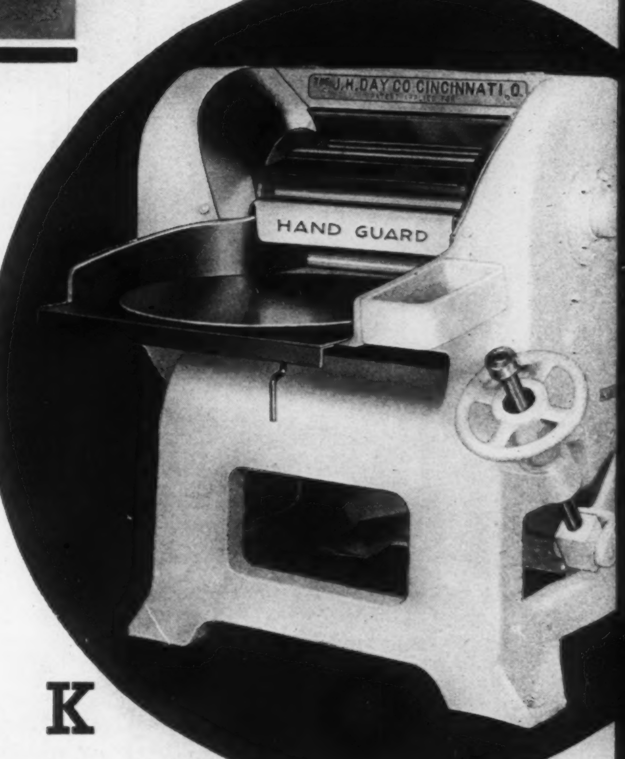


K

Features Machines

Recently Developed Machinery nt of Design Innovations.

t lathe by Bullard Co. incorporates operated speed shift mechanism. instantaneous stopping of feeds. dividual motors for drive, rapid sing is through push buttons and ressure lubrication is employed.

ator and machine are controlled by bar in new unit of One Minute push on the bar and both wringer stantly. Pulling the bar throws cks wringer and brings drainboard n. Synchro-mesh construction, ors and oilless bearings are used.

(G) Crankshaft of compressor, built by Gardner-Denver Co., is of forged steel supported by three main bearings of the bronze-backed, babbitt-lined type. Oil pipes are eliminated by lubricating with pressure feed through drilled passages. Inlet and discharge valves are cushioned.

(H) Unitized construction features Fay & Scott strawberry capper which substitutes mechanical accuracy and speed for uncertain hand operation. Corrugated rubber belts and a stainless steel roll strip the cap from the berry. Each unit is driven by a worm and gear assembly with ball thrust. Stainless steel hopper feed is operated by chain drive.

(J) Absorption of vibration and noise is attained on National Equipment Corp. concrete mixer by mounting the unit on springs. Another change is the use of self-aligning double-row bearings for drum shafts. The unit has a high pressure lubricating system, V-belt drive and thread-lock fastenings.

(K) Bottom roll is placed far back of top roll and raised so that the operator cannot catch his hand, on the dough brake of J. H. Day Co. Direct connected roller chain drive gives quiet operation. A one-piece frame casting completely encloses working parts, including the motor. Note the "streamline" effect.

MACHINE
DESIGN

L. E. JERMY, EDITOR
ALLEN F. CLARK
HAROLD B. VEITH
F. H. BURGESS

Proper Appreciation of Engineering Must Be Fostered

STEPS are being taken by American Engineering Council at Washington to gain increased recognition and salaries for engineers working on projects sponsored by government emergency relief agencies. It is a sad commentary on the engineer and on engineering societies that wages paid technically trained men under C.W.A., for example, have been much less than those of laborers. And the situation is becoming worse, with little or no apparent result from the efforts of organized engineering societies to find a remedy.

One of the contributory causes of this condition, in good times and bad, is the yearly influx into the profession. As shown by David L. Fiske in an article in *Civil Engineering,* there has been during the past 40 years an increase of 216 per cent in the number of engineers between the ages of 25 and 64, as compared with population growth. During this same period the medical profession decreased 23 per cent and lawyers five per cent! Granted that there has been good reason for a large increase in the number of engineers, it is questionable whether the best interests of the profession will be served by continuing expansion in numbers at the same disproportionate rate.

Would it not be more commensurate with the rigorous training of engineers to endeavor to limit the future increase to more normal growth and thus make possible the raising of the engineer's status and salary as well as the market price of engineering materials and services?

• • •

Keep in Touch!

IT IS estimated that several hundred new machines or new models of machines are introduced in this country every month. All of these are basically similar, yet each involves mechanisms and materials peculiar to its type about which designers of other machines often have only scant information.

Among the qualifications of the ideal designer—if he could be found—would be a thorough knowledge of exactly what was happening in design in his own field and a fairly complete grip of innovations and changes introduced in machines for other industries. But such particulars are not easy to obtain.

This is the reasoning behind the pictorial feature on the preceding two pages. MACHINE DESIGN is planning a series of these features to bring to readers in illustrated and summarized form the latest information available on new methods, materials and parts as incorporated in recently designed machines.

PROFESSIONAL VIEWPOINTS

Machine Design Welcomes Letters Suitable for Publication

Investigating Cylindrical Bodies

To the Editor:

STRESSES in thick cylinders are a factor in machine development that often requires considerable attention of designers. If a cylinder is subjected to a uniform pressure over its inner or outer surface, there results a stress in the walls. This stress is ordinarily assumed to be uniform for cylinders with thin walls, but it varies with the radius as shown in the accompanying figure, the curve C representing the stress plotted against the radius.

Cylinders with closed ends have a longitudinal stress induced in the walls because of the pressure on the ends, this stress combining with the tangential stress. The stress equation, known as *Clavarino's* equation, for the general condition of both internal and external pressures, giving the stress p at a section r units from the center, and neglecting the supporting effect of the ends,

$$p=\frac{r_1{}^2w_1-r_2{}^2w_2+4r_1{}^2r_2{}^2(w_1-w_2)/r^2}{3(r_2{}^2-r_1{}^2)}$$

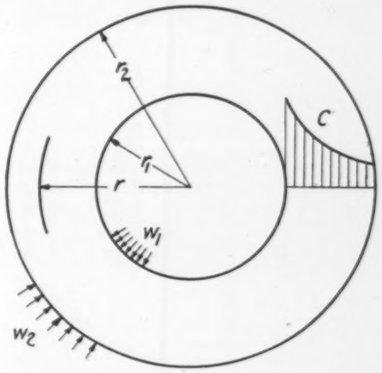
where r, r_1 and r_2 are measured in any common unit as are also p, w_1 and w_2. Usually the application of Clavarino's equation is to cylindrical vessels subjected to high pressure on the inside only, in which case w_2 is zero. In case the pressure happens to be on the outside only, w_1 is zero.

Cylinders with open ends are encountered in hubs and hollow shafts subjected to pressures resulting from force or shrink fits. Generally the pressure acts upon only one surface of the cylinder, a noted exception being a gun upon which are shrunk a number of jackets. The general stress equation for cylinders with open ends, known as *Birnie's* equation, is

$$p=\frac{2r_1{}^2w_1-2r_2{}^2w_2+4r_1\,r_2(w_1-w_2)/r^2}{3(r_2{}^2-r_1{}^2)}$$

The chart on page 38, combining in one figure graphical solutions for both formulas, is unique and entirely new. It is based upon the fact that the pair of values (r_1,w_1), (r_2,w_2), and (r,p) each determines a point. These three points lie on a straight line, enabling one to solve by alignment for any one of the six quantities r, r_1, r_2, p, w_1, w_2 if the other five are known.

In using the chart, it is well to use such a factor as the r's that the inner radius becomes $r_1=2$, thus separating as far as possible the points determined by (r_1,w_1) and (r_2,w_2) and increasing the accuracy of the reading. Thus, if a cylinder with open ends has an inner radius of 4 inches and an outer radius of 6 inches, an internal pressure of 4600 pounds per square inch and an external radius of 1200 pounds per square inch take $r_1=2$, $r_2=3$, $w_1=4.6$, $w_2=1.2$ and we see that p varies from 9.17 when $r=2$, to 4.64 when $r=3$. Hence the stress (tensile) varies from 9170 pounds per square inch at the inside of the cylinder of 4640 pounds per square inch.



In cylinder walls the stress varies with the radius

—O. E. Brown,
Cleveland

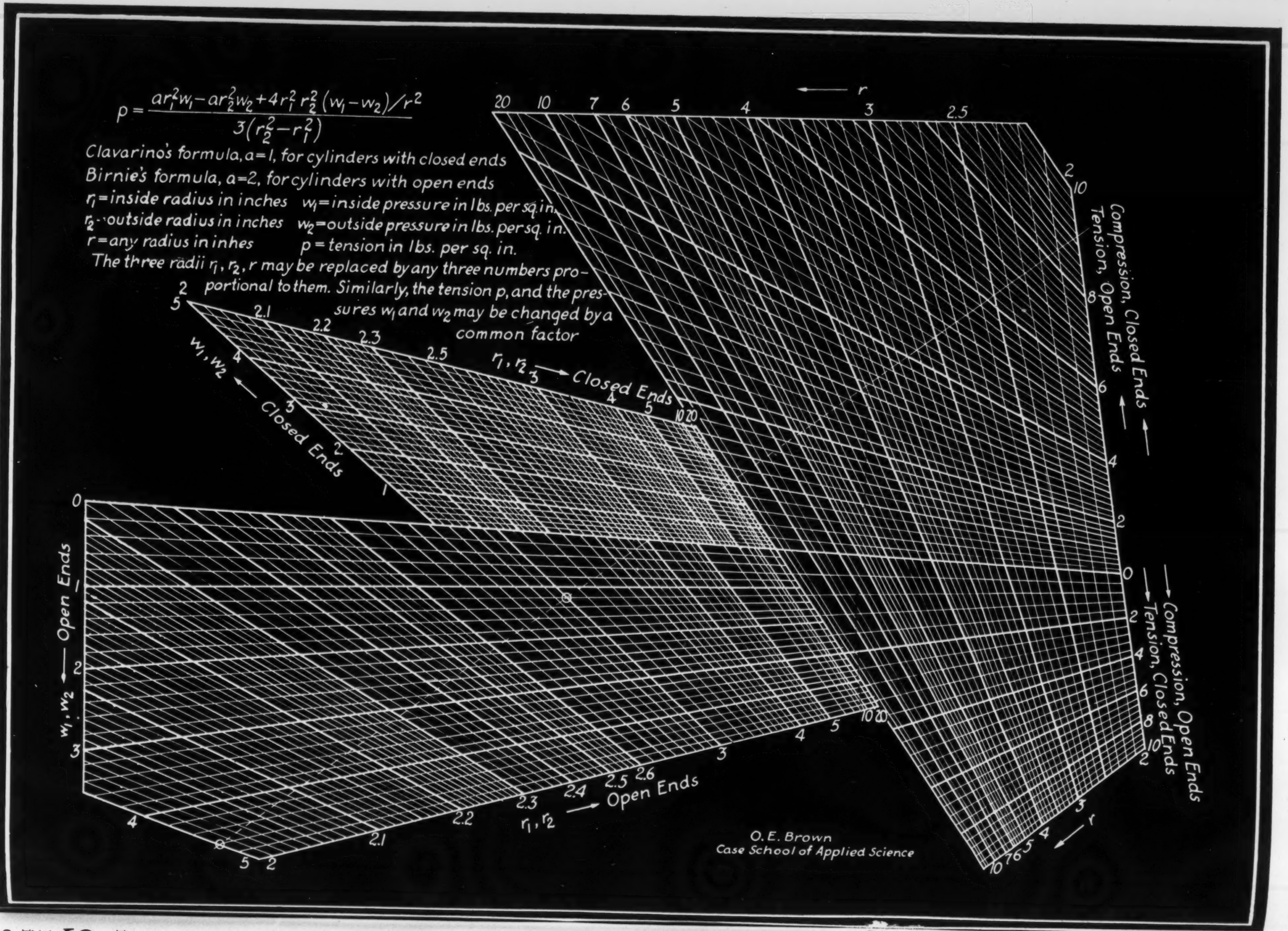
Study Operating Conditions!

To the Editor:

YOUR editorial in the February issue emphasizing the wisdom of machine designers being permitted to obtain first hand information by visiting potential user's plants and seeing the actual service conditions under which a machine must operate is a most timely one. Few designers are offered such opportunities, and then their superiors often wonder why so many alterations must be made after installation of the machine. The expense of such visits often is not approved because it is difficult to measure the results to be derived.

The next best procedure is for the alert salesman or sales engineer to obtain all the information possible concerning the service expected from equipment to be purchased. He should make notes of all conditions surrounding the proposed installation. If the new machine replaces obsolete equipment, he should secure a list of the disadvantages of the latter.

—C. E. Schirmer,
Springfield, O.



$$p=\frac{ar_1^2w_1-ar_2^2w_2+4r_1^2r_2^2(w_1-w_2)/r^2}{3(r_2^2-r_1^2)}$$

Clavarino's formula, $a=1$, for cylinders with closed ends

Birnie's formula, $a=2$, for cylinders with open ends

r_1 = inside radius in inches

r_2 = outside radius in inches

r = any radius in inhes

w_1 = inside pressure in lbs. per sq. in.

w_2 = outside pressure in lbs. per sq. in.

p = tension in lbs. per sq. in.

The three radii r_1, r_2, r may be replaced by any three numbers proportional to them. Similarly, the tension p, and the pressures w_1 and w_2 may be changed by a common factor

O. E. Brown
Case School of Applied Science

TOPICS

TESTS recently conducted by the army air corps reveal that the new high speed types of transport planes are twice as strong as the slower equipment they are replacing. Planes tested included a ten-passenger Boeing air liner which cruises at a speed of 171 miles per hour. Its body was subjected to tremendous loads and did not break under loadings 60 per cent greater than the maximum allowed under the safety requirements for these planes. Fifty tons of lead used to weight the body had no damaging effect; two additional tons were required to break it. Tests on the wings showed that they could withstand weights of about 36 tons, 20 per cent above the minimum requirements.

* * *

Standardization and Research Work Draws Engineering Attention

ACTIVITIES during A. S. T. M. committee week in Washington March 5 to 9 warrant the attention of engineers. There were about 155 meetings including main committees, sections and subcommittees. Registrations numbered 600. A great deal of interest was noted in the extensive standardization and research work which the various groups have underway. Several of the committees offered proposed standards and a number of important specifications and test methods which have been in the tentative stage were recommended to be adopted as standard.

* * *

Alloy Valve Inserts Are Assembled in Dry Ice Process

SUPPLEMENTING the brief discussion on the use of dry ice for contracting metal parts to provide tight fits (M. D. May, 1933, p. 17), it is interesting to note that many automobile, industrial and marine engines now are fitted with hard, tough cast alloy valve seat inserts shrunk in by this process. The method has been adopted as standard practice.

The rings are shrunk about 0.0025-inch, then measuring from 0.001 to 0.0015-inch larger in diameter than the recessed holes into which they are to be fitted. Two light hammer blows drive them into place. When the rings expand to normal diameter at room temperature, they of course become even more tightly fitted in the recessed walls. The dry ice method of seating the rings eliminates distortion of cylinder blocks.

* * *

Dust Is Controlled at Its Source in Rock Excavating Machines

SILICOSIS, a disease brought on by continuous inhalation of fine dust, is being thwarted by the ingenuity of the design engineer. In the March issue was cited a case where a battery of machines for pulverizing ground silica rock was eliminated by a new unit which removes conditions endangering the health of workmen. Waldemar Kaempffert writing in the *New York Times* calls attention to a rock excavating device which controls dust at the source. A metal chamber encloses the drill steel at the hole. As operations proceed dust is sucked out on the vacuum cleaning principle. The apparatus subsequently cleans the air taken from the hole.

* * *

Oil Burner Manufacturers Concentrate on Design and Merchandising

OPTIMISM and business activity marked the recent national oil burner show and convention of the American Oil Burner association in Philadelphia. Exhibits, spread out through 126 booths, revealed that the industry is concentrating its attention on design and merchandising. That manufacturers are keenly designed conscious was amply evidenced by the modernistic, Century of Progress flair in both line and color of the units. Because major engineering problems, relating to silent operation and trouble-free mechanisms have been combated with successful results, efforts now seem to be directed more toward improved appearance.

MEN OF MACHINES

CLOSELY identified with important developments in the welding industry, Everett Chapman needs no introduction to engineers. His success in the photoelastic method of studying welded design has won widespread attention. With Lukenweld Inc., Coatesville, Pa., he now holds the post of vice president. His elevation to this position was announced recently.

Mr. Chapman joined the Lukenweld organization, a division of Lukens Steel Co., early in 1930 as director of engineering and research. Since then he has been credited with the responsibility for that company's engineering achievements in the application of welded steel construction to diesel engines, presses, planers, lathes and other machinery and equipment.

Remarkable accomplishments of a man whose career virtually has only begun have reflected his firm grasp on industrial problems. After graduation in 1924 from the University of Michigan with a master's degree in physics, he taught electrical engineering at Purdue university. Subsequently he joined the Lincoln Electric Co., Cleveland, to engage in experimental research and development.

In addition to his record in industry, Mr. Chapman has been extremely active in technical society work.

EVERETT CHAPMAN

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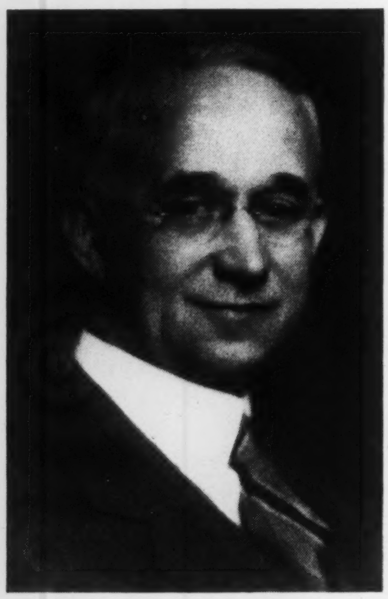

CHARLES V. HAYNES

MEMBERS of the American Society of Heating and Ventilating Engineers have chosen a man of 40 years experience to head their organization. He is Charles V. Haynes who has served as chairman of the committee on research, has been a member of the council for eight years, and held the offices of first and second vice president before becoming chief executive. Mr. Haynes is a native of Middleburgh, N. Y.

As a young man he taught school several years before starting on a business career. His earliest adventure in the mechanical field came when he installed the first steam kiln for drying hoops. During his many years in manufacturing and distributing boilers, radiators and steam heating equipment, he has been interested in the general development and improvement of these devices and has patented vapor and modulating valves.

Following his service in the supply field, Mr. Haynes spent a number of years with the Wm. H. Page Boiler Co. and the American Radiator Co. before returning to the supply business in Philadelphia. Later he formed a heating specialty firm and in 1922 joined the Hoffman Specialty Co. where he became vice president and general sales manager. In 1917 he was made a member of the Society which he now serves as president.

BESIDES holding many patents, William M. Horton has been responsible for notable improvements in machinery and methods of manufacturing in the bolt and screw industry. His leadership in this field finds reward in a new position as factory manager of the Ferry Cap & Set Screw Co., Cleveland. Mr. Horton is a graduate of Port Chester high school, Port Chester, N. Y., and of Pratt institute, Brooklyn, N. Y., in 1909.

Early experience included four years as apprentice in toolmaking, machine shop practice and drafting at Russell, Burdsall & Ward Bolt & Nut Co., Port Chester. There he received the groundwork for his knowledge of the manufacture of bolts, nuts and kindred products. In 1912 he went to Cleveland where for a period of 15 years he was associated with the late S. D. Latty of the Kirk-Latty Mfg. Co., subsequently consolidated with Lamson & Sessions Co. In the merged organization Mr. Horton was made assistant director of operations under Maj. R. H. Smith.

Technical society affiliations include the Society of Automotive Engineers as well as the American Society of Mechanical Engineers. He has served as chairman of subcommittee No. 5 on bolt and nut standards of the latter organization.

WILLIAM M. HORTON

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EASTMAN N. JACOBS

TO EASTMAN N. JACOBS goes the 1933 Wright Brothers medal for his paper "The Aerodynamics of Wing Sections for Airplanes," presented before the Society of Automotive Engineers last fall. He is engaged in aerodynamic research at Langley Field laboratories of the National Advisory Committee for Aeronautics, and is a founder member of the Institute of the Aeronautical Sciences.

Although he is regularly engaged in work of a scientific nature, in the design field his accomplishments include the responsibility in whole or in part for the design of various pieces of research apparatus. This comprises much of the interior structure and equipment in a redesigned variable density wind tunnel, a smoke-flow tunnel for making air flows visible, and a water tunnel for studying cavitation. Mr. Jacobs has outlined and directed the research which recently culminated in what is probably the most comprehensive study of airfoil characteristics thus far made.

Born July 19, 1902, in Greeley, Colo., Mr. Jacobs attended University of California, graduating with honors in 1924 from the course leading to the degree of B.S. in electrical engineering. Subsequently, he joined the engineering staff of the Pacific Telephone & Telegraph Co. In 1925 he became a member of the aeronautical staff of the National Advisory Committee for Aeronautics.

• • •

EDWARD S. MCPHERSON, for the past few years assistant chief engineer of Hupp Motor Car Corp., Detroit, has resigned and joined the staff of O. E. Hunt, vice president in charge of engineering, General Motors Corp.

* * *

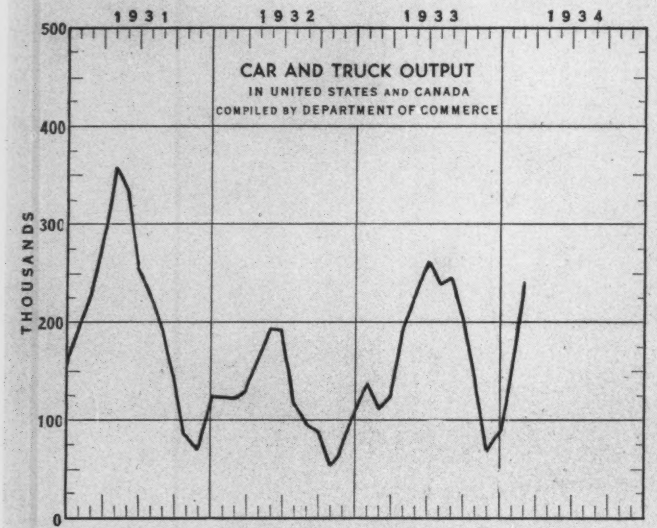
JACKSON H. PRESSLEY has been appointed chief engineer of the Zenith Radio Corp., Chicago. He has been connected with the radio industry since its inception and at one time was identified with the radio laboratories of the U. S. Signal Corps.

P. A. COLLINS, recently with Bendix Brake Co., now is in charge of experimental engineering at Chevrolet Motor Co. R. S. Plexico, formerly with Willys-Overland Co., has joined Chevrolet as special engineer on chassis units.

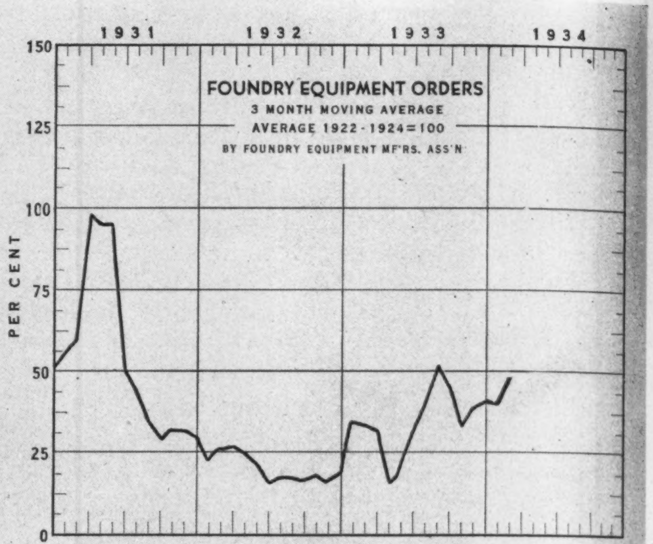
* * *

DR. LEWIS B. STILLWELL, New York consulting engineer, recently received the Lamme medal of the American Institute of Electrical Engineers. Award was made for his distinguished career in connection with design, installation and operation of electrical machinery.

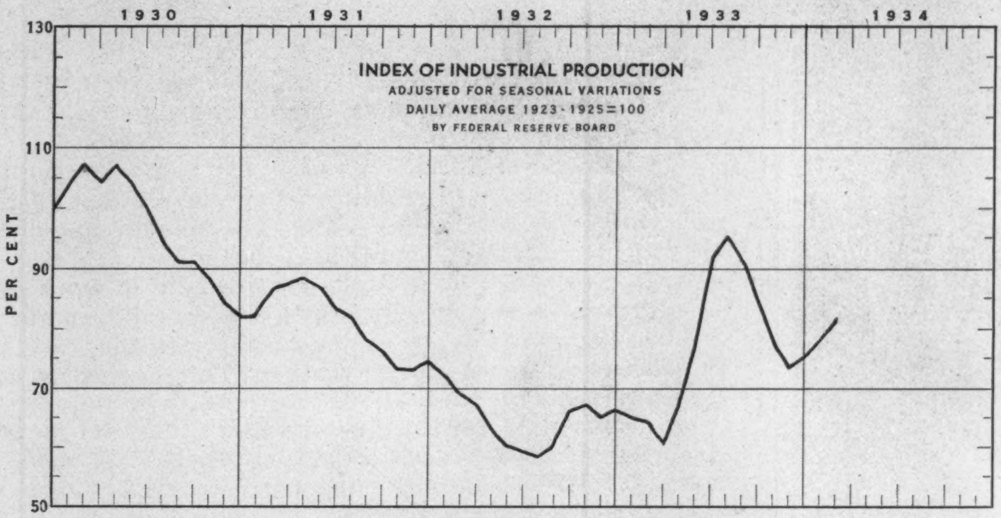
How Is Business?



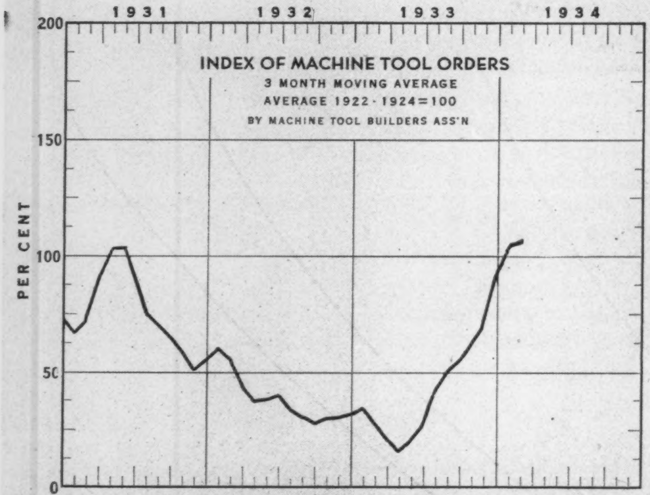
Feb. 1933, 110,186—*Feb.* 1934, 243,947



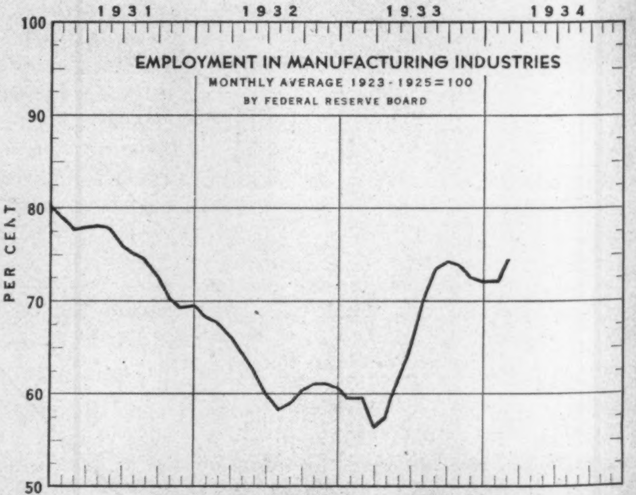
Feb. 1933, 34.4—*Feb.* 1934, 48.9



Feb. 1933, 63—*Feb.* 1934, 81



Feb. 1933, 27.5—*Feb.* 1934, 104 8



Feb. 1933, 59.4—*Feb.* 1934, 74.7

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NOTEWORTHY PATENTS

ROTATION of a take-up reel so that tape from a punching machine is maintained under a substantially constant tension is accomplished in patent No. 1,937,499 issued to Arthur H. Adams and assigned to General Cable Corp. The perforated tape is delivered to the take-up mechanism from the ironing or feed rolls 31, *Fig.* 1, passing around an idler 61′ before being delivered to take-up reel 62.

The reel is supported upon drive shaft 63 driven from power shaft 33. A band type drive clutch drum 65 is secured to reel shaft 63 and the reel itself is mounted upon a roll supporting member 66 supported on bearing 67 so that it is freely rotatable with relation to shaft 63. A pin 68 mounted in the lower face of reel support 66 extends downwardly through slot 69 in an intermediate control drum 70 and has its lower end connected to one end of a clutch band 71 which extends around the lower driving clutch drum 65 and is connected at its opposite end to pin 72 secured to the intermediate control drum 70. A spring connects pin 70 to pin 72, tending to exert driving pressure in the clutch band.

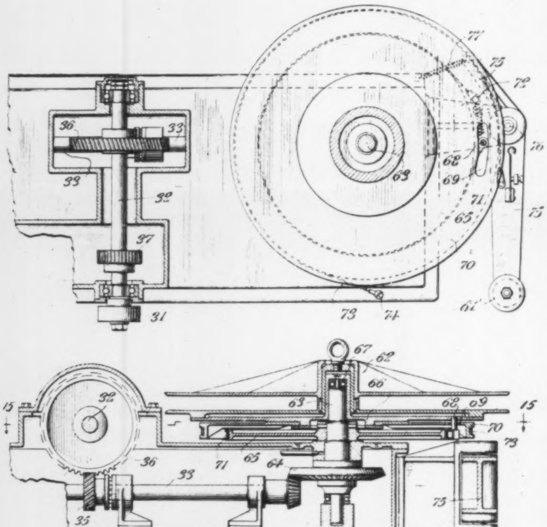


Fig. 1—Constant pressure is maintained on tape being delivered from perforating machine

A brake band 73 surrounds the intermediate control drum 70 and is connected at one end to pin 74 mounted on the machine frame, and at its other end to one arm of lever 75 pivoted at 76 to the machine frame and supporting on its other arm the idler roller 61′. Spring 77 tends to draw the lever into brake releasing position while any increased tension on the tape tends to swing the lever so as to apply the brake band 73.

In normal operation, reel 62, supporting member 66, intermediate control drum 70 and the driving clutch drum 65 rotate together through the pressure of the clutch band on the drum 65. Should pressure be exerted on brake band 73 through action of lever 75, control drum 70 would be slowed down to a stop, the end of the slot in this drum would contact pin 68 and would operate against the spring to release the pressure on clutch band 71, thus permitting the reel and associated parts to slow down until such time as the pressure on the brake band is released. The intermediate drum 70 permits the action of the spring to bring pins 68 and 72 again into proper relative position and thus cause pressure to be exerted on the clutch drum.

A DEFINITE and certain length path through which moving picture film with its sound striata may be threaded so that an exact length of film is disposed between the light aperture and sound aperture is insured by a film threading mechanism patented by Augusto Dina and assigned to International Projector Corp. This exact length is made necessary by the distance between the two apertures in the speaking-movie projector and the necessity that as a given picture section is framed in the projection light aperture, the corresponding sound portion of the film is framed in the projection sound aperture.

The patented mechanism, obviating possible errors in judgment of the operator, works entirely by leverage. As shown at the right of *Fig.* 2, the film, as normally is the case, travels from the upper magazine down around roller 24 to form loop *A*, and then through the trap formed by gate 10 and door 11. Passing around intermittent sprocket 26 it forms loop *B* with the lower feed sprocket 27; then it forms loop *C* and passes through the trap formed by gate 22 and door 23 which is the sound trap. After this it forms loop *D* and passes around take-up sprocket 29.

The system employed comprises lever 30

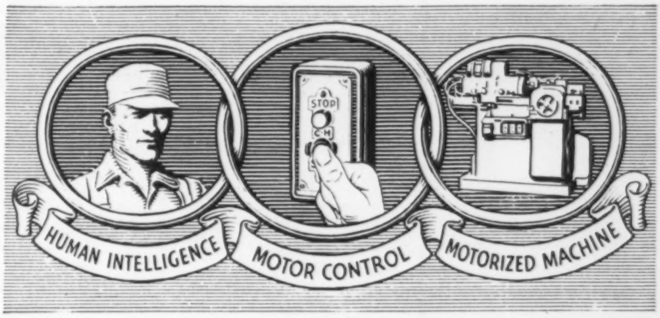
LINKING TRAINS brings *SPEED* with *SAFETY*

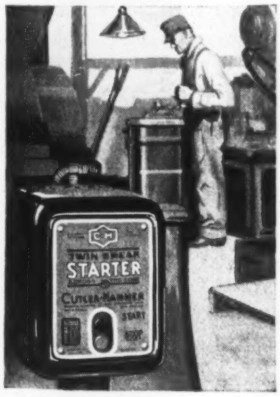
MOVING units, whether they are railroad trains or machines in Industry must be linked to human intelligence. Modern railroading depends on communication for fast, accurate control. In Industry the *vital* link is Motor Control.

Being the *vital* link in the mastery of man over machines, Motor Control is far more important than either its size or cost indicates. It is a factor in the speed and dependability of production, the quality of workmanship, the cost of power and maintenance, the safety of men, motors and machines.

Wise builders of motor-driven machines never lose sight of this important fact. They see Motor Control as much more than a small, low-cost unit in their designs. They recognize Motor Control as the one link between human intelligence and machine performance. They refuse to hazard the consequences of *indifference* toward Motor Control.

Standardize on Cutler-Hammer Motor Control to insure the performance of your machines and to add another sales feature at no expense. You, too, should call in C-H engineers while designs are in the blueprint stage. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus*, 1310 St. Paul Ave., Milwaukee, Wis.





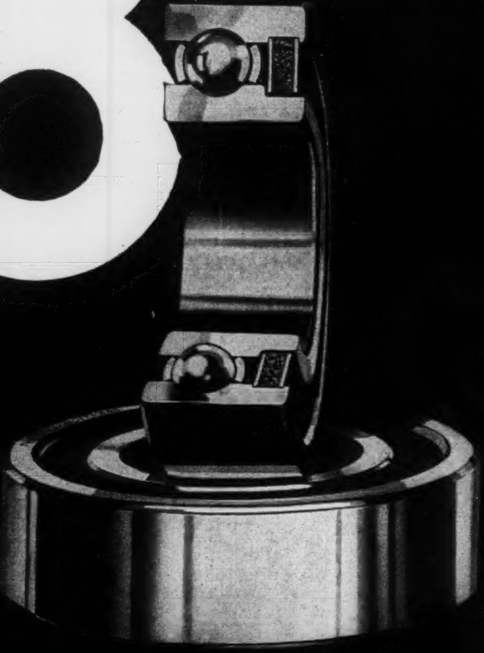
The designing and building of Motor Control is a separate and distinct division of electrical engineering. The place to go for consultation and advice on Motor Control problems is to a control specialist. Cutler-Hammer indisputably qualifies as such a specialist. Your problems will be welcomed here. A letterhead request brings the C-H Catalog.

CUTLER HAMMER

The Control Equipment Good Electric Motors Deserve

(B-219)

8 POINTS OF SUPERIORITY



①Thick, closely-fitting felts, providing extra protection.

②Effective labyrinth, formed by felt seal and plates against recessed inner ring.

③Seal removable in its entirety—for inspection, cleaning, or renewal of felt if needed.

④Felt seal within confines of inner and outer rings and therefore not exposed to injury.

⑤Wide, solid inner and outer rings, with maximum contact on shaft and housing, make inserts in housing unnecessary and militate against slippage, looseness, and escape of lubricant past outer ring.

⑥Outer ring can be clamped on both faces.

⑦A self-contained all-steel unit; construction assuring dimensional exactness and quiet running.

⑧Grease capacity ample for long periods of service.

Write for the Catalog, describing this 7000 Series "GreaSeal" Bearing, together with the complementary line of adjusting springs, felts and washers.

GREASEAL
FELT—PROTECTED
‹ PATENTED ›

NORMA-HOFFMANN BEARINGS CORPORATION, STAMFORD, CONN., U. S. A.

which has a roller 31 at one end. The other end is connected to link 32 connected to the upper end of another lever 33 which is pivoted at 34 and has at its further end roller 35. To this end of lever 33 there is connected link 36, the other end of which is connected to lever 37 pivoted at 38. The opposite end of lever 37 has roller 39.

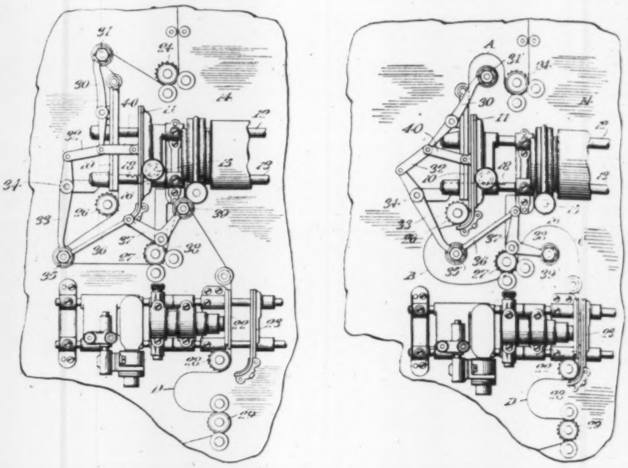


Fig. 2—*Leverage system permits exact proportioning of of film in sound movie projector*

The lower end of lever 30 is connected by link 40 to door 11 so that as the door is moved the lever system is actuated. This actuation is such that when the door is closed the lever system assumes the position shown at the left in *Fig.* 2 as contrasted with the right view showing the door open. Movement of door 11 is controlled so that it is locked in place at each end of its travel.

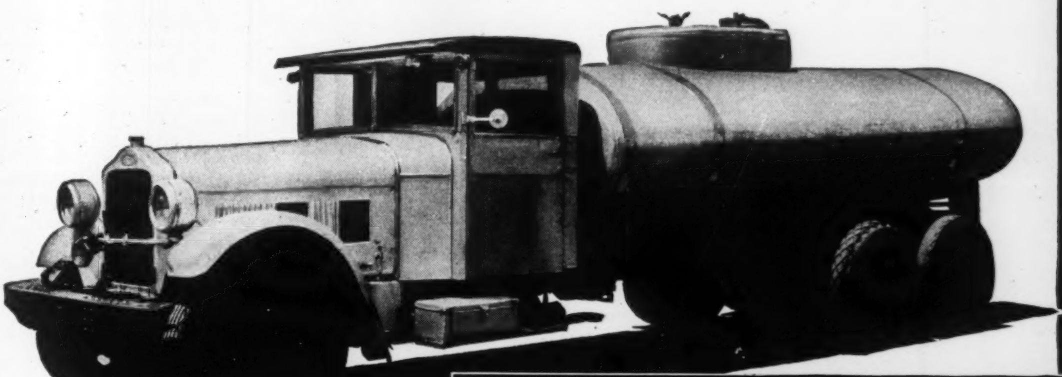
The patent is designated as No. 1,949,457.

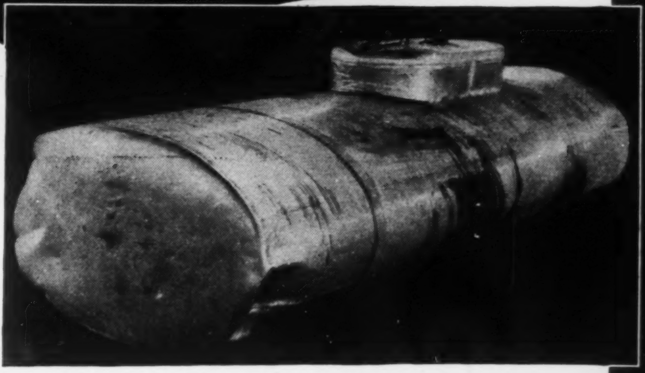
TO METER automatically the flow of water in proportion to the external water pressure in an electric water heater and to control the current so that there will be no danger of burning out, Lee B. Green has secured patent No. 1,938,327, assigned to Globe Machine & Stamping Co., on a combined pressure regulator and switch. When the supply of liquid through pipe 47 is shut off or is at a pressure below that for which spring 26 is adjusted, this spring flexes the diaphragm downwardly, left of *Fig.* 3, so that washer 20 closes the upper end of upright body bore 2. This is the entrance end of the outlet passage. When this action takes place the upper part of groove 53 in valve plunger 18 is entirely housed by a part of the cylindrical bore in which this plunger slides, thereby affording a second seal against leakage of liquid from the inlet to the outlet.

As soon as liquid under suitable pressure is admitted, the upward pressure on the diaphragm will raise it; and as soon as a part of the upper wall of the oblique plunger groove 53

WOULD ORDINARY JOINTS

weather this?





Oxwelded aluminum gasoline-truck tank before and after the accident. Not a welded joint failed.

Oxwelded Joints Held Where Others Failed

WHEN this 3,000-gallon, aluminum gasoline-truck tank took the road, nobody knew it would land in a ditch six months later—with the results shown in the second illustration! Yet it did, and the oxwelded joints were put to as severe a test as anyone could ask.

Being bent double for thirty inches didn't destroy the oxwelded joints a bit. Though the tank was fully loaded, not a leak developed. But the trailer's tank, which was not oxwelded, split wide all along the longitudinal seam . . . which proves, about as well as anything can, that oxy-acetylene welded joints give a product the extra strength it needs in times of trouble.

If such extra strength would improve your product, let The Linde Air Products Company explain oxwelding's many other benefits to you. Twenty years' experience in applying oxwelding to every type of product has given this company a fund of data which may be just what you are looking for. It will pay you to find out. No obligation is involved—so write or 'phone today to the nearest district office.

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LINDE OXYGEN
Prest-O-Lite
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Oxweld
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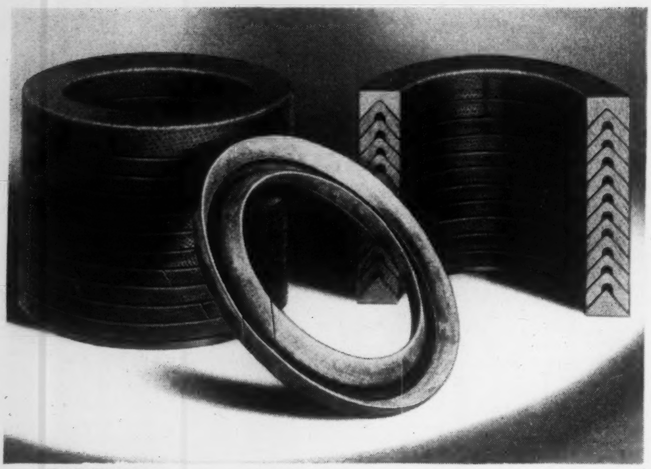

PATENTED

GARLOCK CHEVRON

adjusts itself automatically

Garlock Chevron Packing permits free operation without leakage and with minimum friction—even under severe service conditions.

As the pressure increases, Chevron Packing automatically tightens . . . as the pressure decreases, the packing eases off without re-adjustment of the gland.

Our Engineering Department will be glad to assist you in designing stuffing boxes to accommodate Chevron Packing or other Garlock Packings. Call upon us at any time.

THE GARLOCK PACKING CO.
PALMYRA, NEW YORK

In Canada:
The Garlock Packing Company
of Canada, Limited,
Montreal, Quebec

GARLOCK
Quality Controlled
PACKINGS

is at higher elevation than washer seat 1*B*, liquid will flow through this groove into annular passage 2*B*, bore 7 and outlet 8 to the heater. As liquid pressure increases, the upper end of the groove will be correspondingly raised, thereby increasing the effective area of the liquid passage until the plunger is in its midheight position in which the groove presents effective cross sections of equal area both above and below annular flange 6. This permits liquid to flow past the valve at the rate for which the heating member of the unit is designed.

However, if liquid pressure becomes still greater, the resulting further lifting of the diaphragm and the valve plunger will decrease the area of the opening at the lower end of the groove, thus reducing the flow past the valve with an excess of pressure. With an unduly high pressure, the diaphragm will flex upwardly until pressure member 21 engages stop element 13*A* on the cover, halting further lifting.

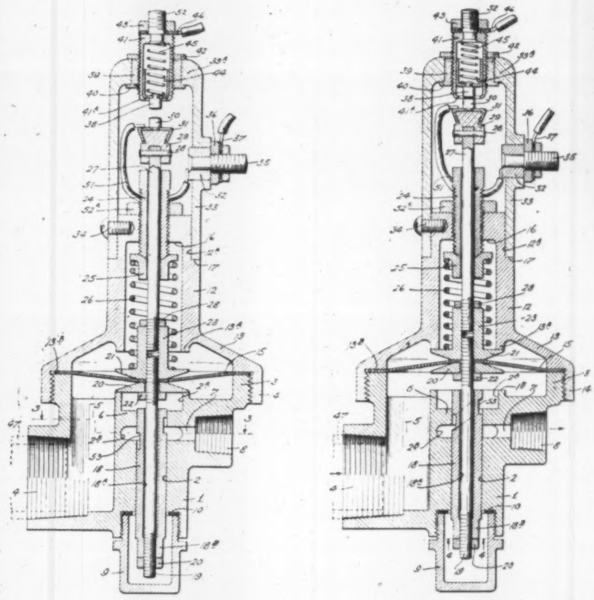
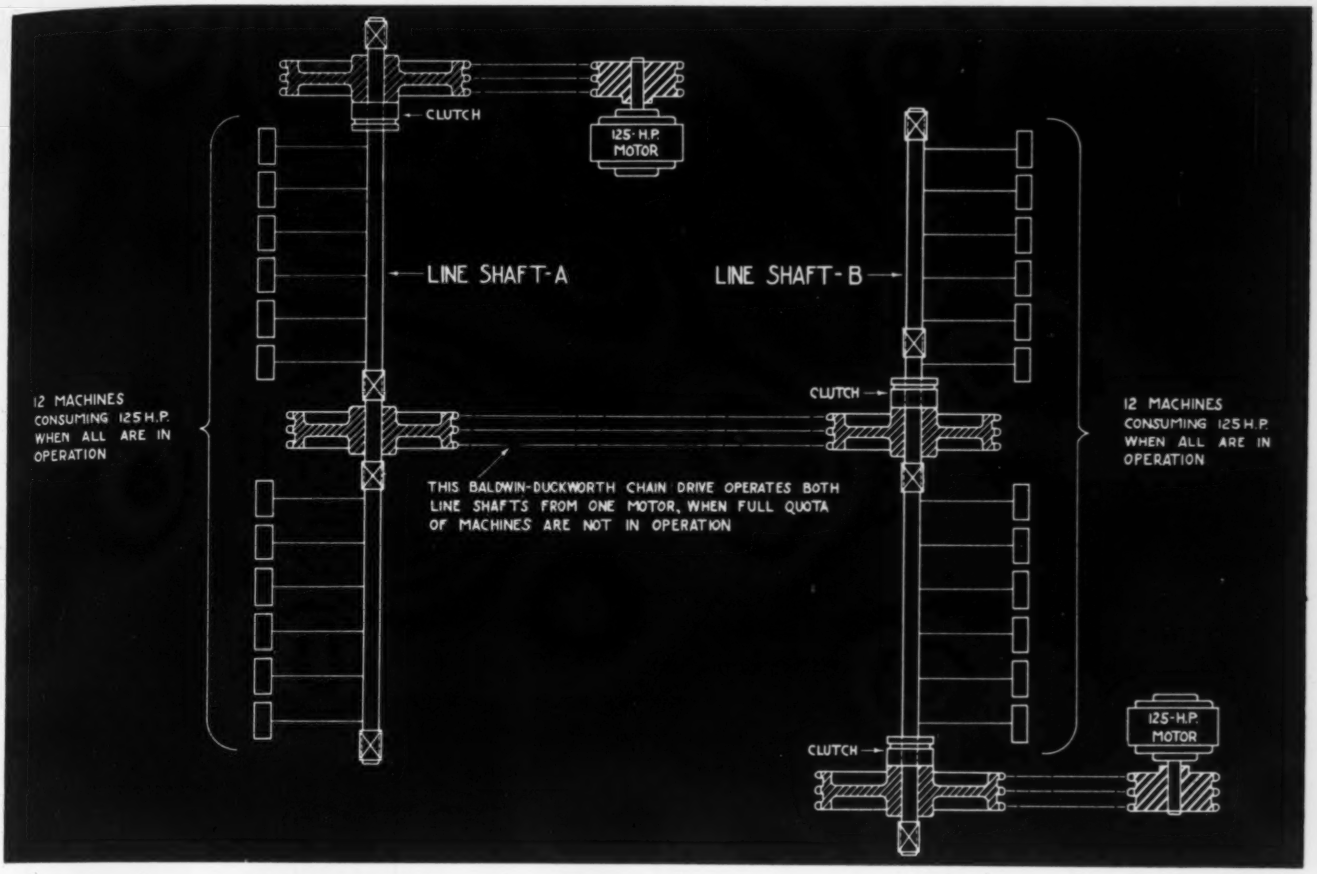


Fig. 3—Both flow of water and electric current are controlled automatically

To afford a corresponding circuit control, the upper stem is adjusted so that with the diaphragm flexed downward by the spring in the valve closing position shown at the left of *Fig.* 3, contact members 30 and 38 are spaced from each other by a distance about one-half the extent of vertical movement permitted to the plunger. Then when the plunger and stem assembly is raised even less than that of the midpoint, the contact members will engage to close the circuit and the yieldable mounting of the upper contact member will allow this member to raise a correspondingly greater extent while holding the circuit closed. However, engagement of presser element 21 with shoulder 13*A* limits this raising so as not to overstrain the spring associated with it.


CLUTCH
125-H.P. MOTOR
LINE SHAFT-A
LINE SHAFT-B
12 MACHINES CONSUMING 125 H.P. WHEN ALL ARE IN OPERATION
CLUTCH
12 MACHINES CONSUMING 125 H.P. WHEN ALL ARE IN OPERATION
THIS BALDWIN-DUCKWORTH CHAIN DRIVE OPERATES BOTH LINE SHAFTS FROM ONE MOTOR, WHEN FULL QUOTA OF MACHINES ARE NOT IN OPERATION
125-H.P. MOTOR
CLUTCH

BALDWIN MADE IN U.S.A.
BALDWIN MADE IN U.S.A.

HE SAVED 125 H.P.

This plant manager had two batteries of different machines which were operated from two parallel lineshafts driven by 125 H.P. motors. Sometimes all the machines were in operation at once; usually half or even fewer. How to operate the *busy* machines in *both* batteries with *one* motor? He solved it very neatly by installing an inexpensive Baldwin-Duckworth Triple Chain Drive connecting the two shafts. (See diagram). The result: Tremendous power cost saving, reliable operation, minimum cost and installation expense.

Maybe an adaptation of this idea would save you money too. We have accumulated a great deal of data on the correct selection of machine finished roller chains and sprockets for all power transmission work, and are in a position to furnish expert engineering advice to any plant wishing to consider installations. Much of this is contained in our new roller chain book. Better send for a copy if you haven't one.

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BALDWIN DUCKWORTH

Factories at Springfield and Worcester, Massachusetts

CULLMAN SPROCKETS

ORDER YOUR SPROCKETS FROM A SPROCKET SPECIALIST

Cullman sprockets are made on machines especially designed for sprocket manufacture . . . by an organization that has specialized in this field for twenty-five years.

Accuracy is the slogan in the Cullman plant . . . accuracy in transmitting the order to the shop . . . accuracy in manufacture . . . accuracy (and promptness) in shipping the product.

That is why many manufacturers have, year after year, found Cullman a dependable source for all their sprocket requirements.

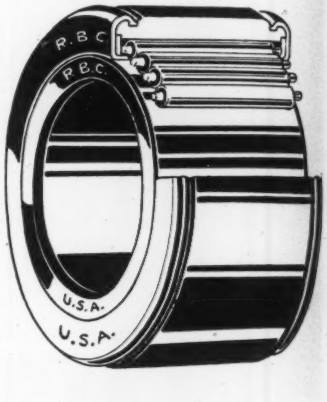
If you use sprockets, you should have the Cullman Sprocket book . . . 125 pages of data and information on sprockets and chains.

Cullman Wheel Co., 1356 Altgeld St., Chicago, Ill.
Send me the Sprocket Book.
Name..........
Company..........
Address..........

New Materials and Parts

Coupling Is Self-Aligning

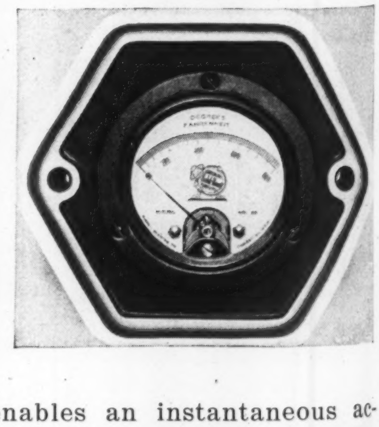
TRUNNION end-type rollers retained in the inner area of the outer race by two roller retainer washers which are knurled over the ends of the outer race and maintained in a rigid and fixed position, are used in the new bearings announced by Roller Bearing Co. of America, Whitehead road, Trenton, N. J. Hardened steel plates are interposed between the end rings and the ends of the rollers to serve the dual purpose of definitely locating the position of the rollers and resisting wear.



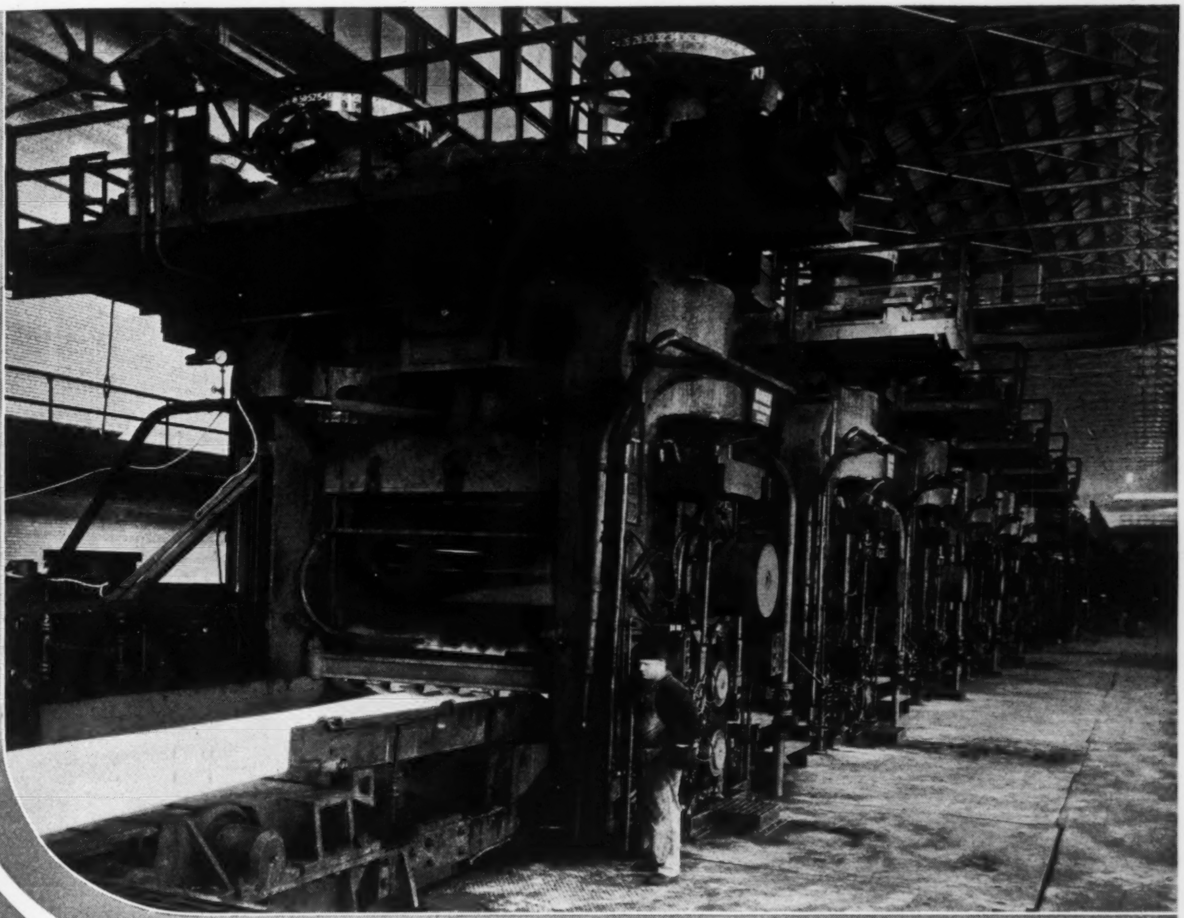
Self-contained bearing is designed to operate on hardened and ground shafts. An inner race can be obtained if necessary

Pyrometer Is of Compact Design

DEVELOPED for incorporation in the machine to be checked, the Hold-Heet pyrometer of Russell Electric Co., 332 West Huron street, Chicago, enables an instantaneous accurate determination of the operating temperatures whenever this knowledge is desired. The pyrometer, shown herewith, is permanently mounted in a position that is not subject to the



Pyrometer extension leads may be be attached to the top, the bottom or either side of the case



A CONTINUOUS MILL 2100 FEET LONG

● Illinois Steel Company's new 96" Continuous Plate Mill represents the last word in the control of rolling operations to assure a high degree of accuracy in size and finish.

The mill is more than a third of a mile long—from soaking pits to the last of the nine stands of rolls. Yet so precise is the control that rolling speeds of 700 feet per minute can be attained.

The mill has a capacity for plates up to a width of 84 inches, a length of 140 feet, and in thicknesses from one-eighth inch up.

Illinois Steel Company
SUBSIDIARY OF UNITED STATES STEEL CORPORATION
208 South La Salle Street, Chicago, Illinois

US STEEL

ILLINOIS PLATES

G. P. & F.
Stampings

G. P. & F. offers more than just the use of a lot of presses

G. P. & F. offers you 53 years of stamping experience — under one management. That means reserve knowledge to call upon — knowledge of every possible short cut.

G. P. & F. experience means uniform quality — minimum machining costs in your assembly department. It means economy in die costs; frequently G. P. & F., because of their vast experience and large tool equipment do not have to start dies "from scratch". It means accurate cost estimates — no surprises.

Although this experience is the chief reason for bringing your stamping problems to G. P. & F. — and bringing them early — the G. P. & F. plant is also an important reason. This 19-acre plant, filled with the most modern stamping and forming equipment, far exceeds the facilities any one manufacturer could afford to maintain.

Take advantage of G. P. & F. experience and facilities. Start by writing for the idea-inspiring booklet *"In Harmony with Modern Progress"*.

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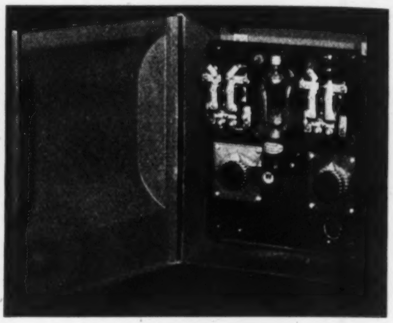
G.P.&F.
STAMPINGS

heat of the machine. No connection leads are employed, and the No. 6 gage thermocouple extends direct from the meter to the point where temperatures are to be measured. The hexagonal aluminum case is so designed that the pyrometer extension leads may be attached to the top, the bottom, or either side of the case.

Electronic Units Measure Time

ELECTRONIC timers which measure a preset length of time and close or open contacts for that time after the initiating impulse given from a push button, foot treadle or cam-operated switch have been developed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The time measured by the control, shown herewith, is continuously adjustable from 1/10 to 45 sec.



Timing is variable by means of a coarse and fine adjustment in timers which measure a predetermined period

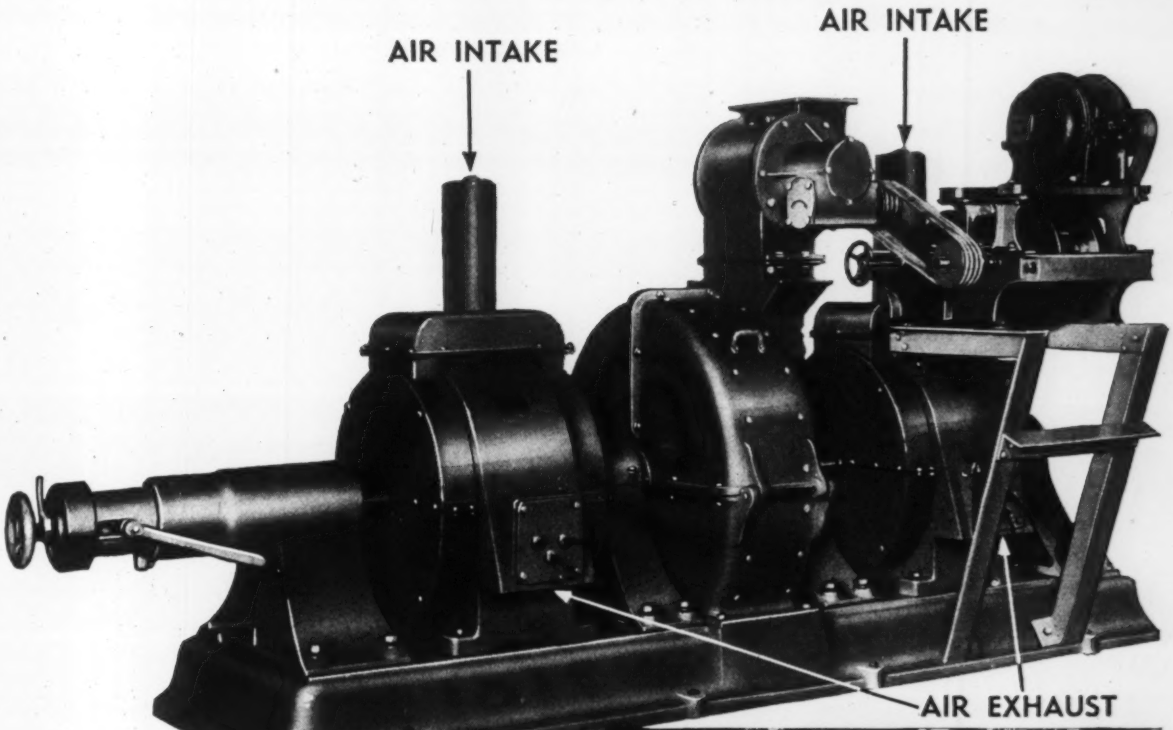
Timing is variable by means of a coarse and a fine adjustment. The coarse adjustment consists of a tap switch for changing connections to fixed resistors. The fine adjustment is a wire wound potentiometer.

Rubberized Fabric Employed

FAIRLY large misalignments are accommodated by the Flex-Align coupling announced by Baldor Electric Co., 4357 Duncan street, St. Louis. This new coupling, shown herewith, is also vibration absorbing and universally flexible. The special rubberized fabric driv-

Rubberized fabric forms the driving members in vibration absorbing coupling

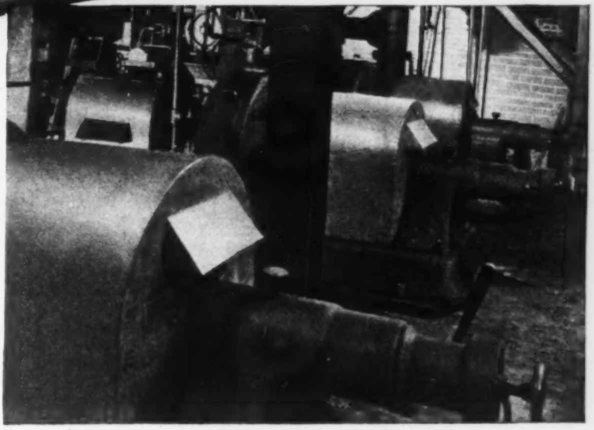
How the RIGHT Motors Solved the Drive Problem of This Modern Mill



THIS new attrition mill, built by Sprout, Waldron & Company for pulp-grinding service, is driven by G-E totally enclosed, separately ventilated motors. The ventilating air, maintained at constant pressure within the motor housings, excludes the moisture and the corrosive fumes which surround the drive.

Because of this design, the cumbersome sheet-metal enclosures formerly used are now unnecessary—eliminated by motors that meet the mechanical as well as the electrical requirements of the driven equipment. Thus, space is saved, appearance is improved, maintenance is reduced.

For your equipment, too, the *right* motors, supplied by General Electric, can provide many advantages—save you money. Why not investigate the opportunities available in the *complete* G-E line? A specialist at the nearest G-E office will be glad to coöperate in the selection not only of motors, but of control, transformers, wire and cable—in fact, your every need in electric equipment. General Electric, Dept. 6B-201, Schenectady, N.Y.

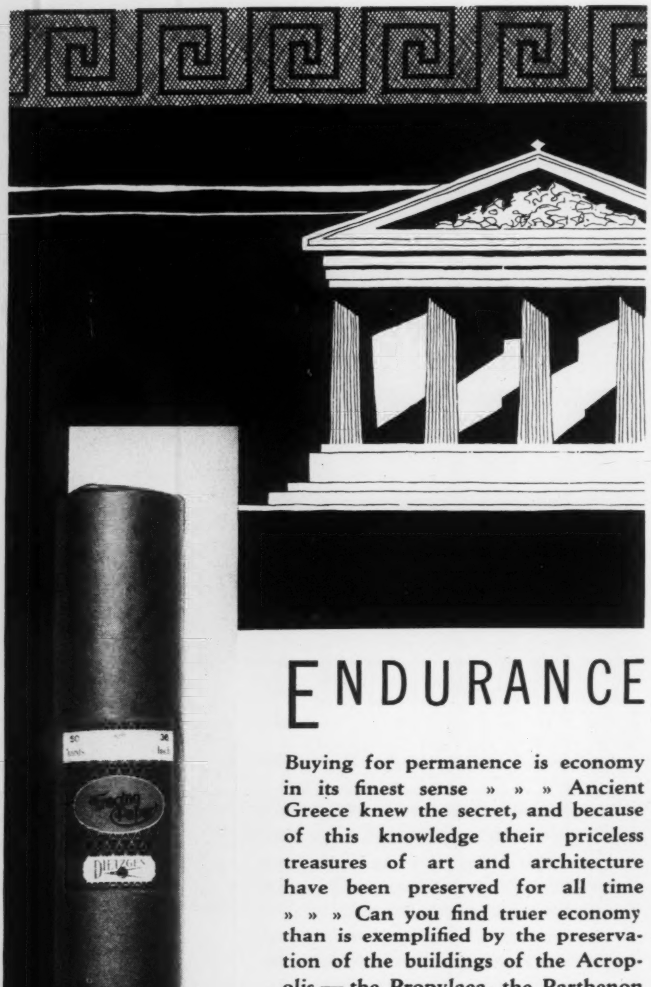


The Old Way

In similar applications, open-type motors were formerly used. Located amid splashing liquids, the motors had to be protected by bulky sheet-metal enclosures, as shown above. Even then, they were subjected to the moisture and the corrosive fumes present

020-2

GENERAL ELECTRIC



ENDURANCE

Buying for permanence is economy in its finest sense » » » Ancient Greece knew the secret, and because of this knowledge their priceless treasures of art and architecture have been preserved for all time » » » Can you find truer economy than is exemplified by the preservation of the buildings of the Acropolis — the Propylaea, the Parthenon and the Erechtheum? They prove conclusively that the Greeks were truly in every sense masters of materials and methods » » » In the selection of tracing papers and vellums the same principles apply. Economy not only in cost, but in time and effort are factors which should influence every purchase. The strength, keeping quality, freedom from odor or discoloration, tracing and blueprinting transparency, surface, glaze, tooth, thickness, erasing qualities, and adaptability for ink, pencil or color work — are salient features which simplify or complicate your task.

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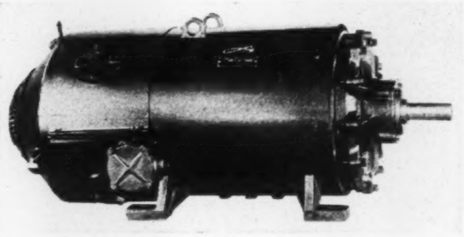
ing members are resilient and all parts are fastened together, thus eliminating loose parts which might rattle.

Introduces Explosion Proof Motors

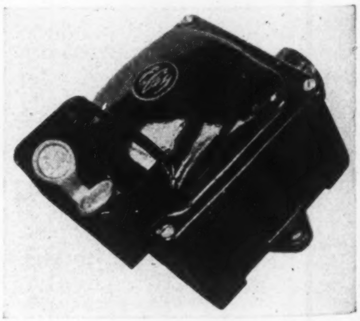
DIRECT current, fan cooled, explosion proof motors have been added to the line of explosion proof equipment being manufactured by Louis Allis Co., Milwaukee. Quick and easy inspection of the commutator and the brushes is made possible by three conveniently removable screw caps. The accompanying illustration is of a 25 horsepower direct current explosion proof motor which operates at 806 revolutions per minute.



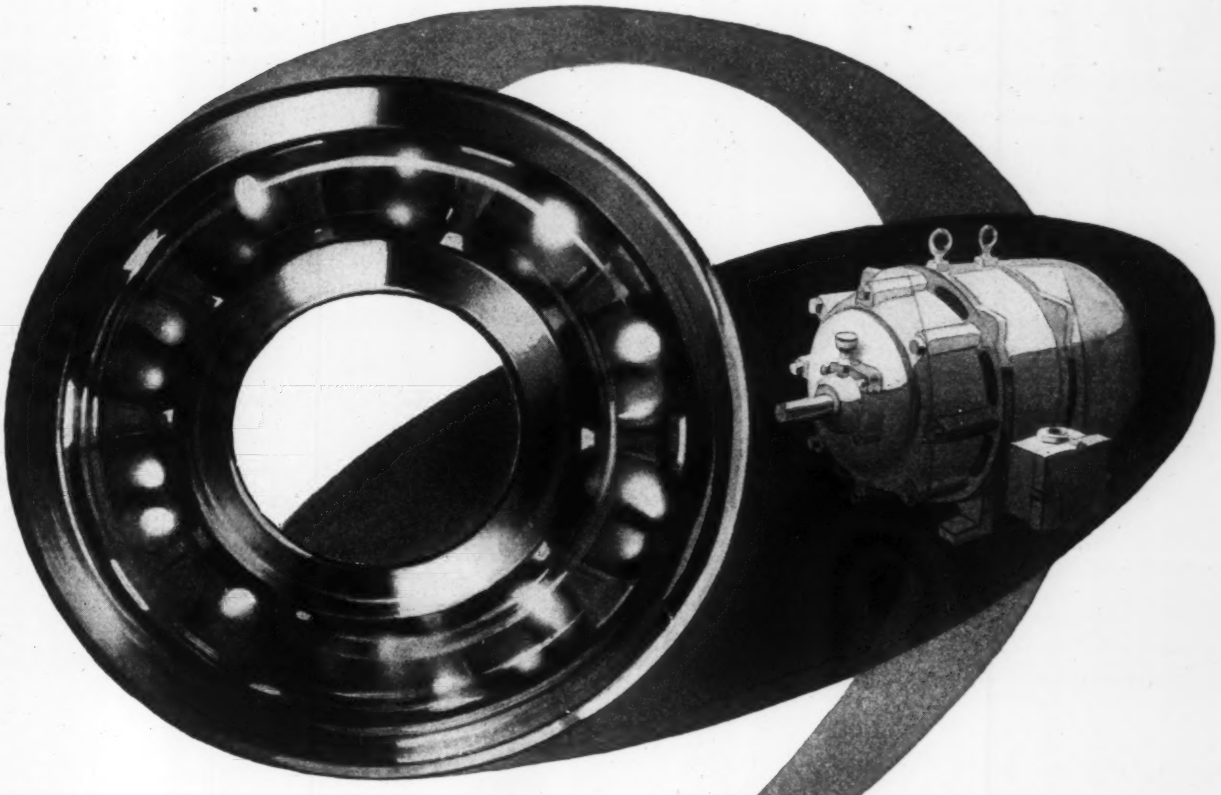
Direct current, explosion proof motors are of the fan-cooled type

Push Button Is Dust Tight

FOR use in connection with remote control of automatic motor starters, Electric Controller & Mfg. Co., 2705 East Seventy-ninth street, Cleveland, has brought out a safety lockout push button. This push button, shown herewith, is for 3-wire low voltage protection installations where it is desired to start and stop a motor through its magnetically operated starter or controller from two or more push button control stations, at any one of which it may be desired to lock the push button in the "off" position to



Safety lockout push button prevents operation until the machine is ready to run



Which bearing *to assure lasting efficiency?*

How long will the rotor spin with its designed efficiency? That's a question designer and user alike may well ask. In the long run the answer revolves around the bearings.

It takes more than just a good ball bearing. Bearing fit, lubrication and housing design are vital. The answers involve more than theory. Experience alone can dictate the ideal combination.

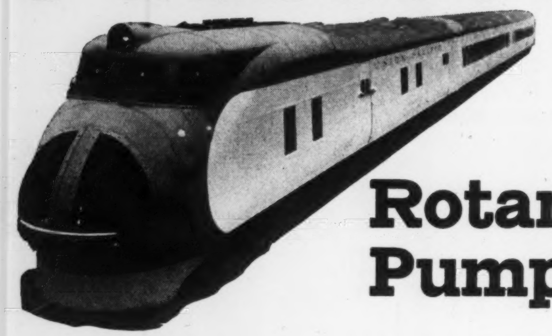
Long years of cooperation with motor builders and users in every branch of industry make Fafnir particularly qualified to supply the solution. And the consistent precision of the bearing dimensions assures perfect duplication of performance whether a few or a few thousand bearings be needed.

Take full advantage of Fafnir's experience. Have our specialists recommend the bearings which will assure new motor performance for years to come. This service is yours for the asking. THE FAFNIR BEARING COMPANY, *New Britain, Conn.* Atlanta . . Chicago . . Cleveland . . . Dallas . . . Detroit . . . . Milwaukee . . Minneapolis . . New York . . Philadelphia.

"THE DRAGON" *Speaks*
It tells of economies effected by bearing engineering in every branch of industry. We will gladly send you copies. Just drop us a line.

FAFNIR BALL BEARINGS

VIKING



Rotary Pumps

Sail the rails on the New Stream-lined Trains

THE giant 600 horsepower Winton Diesel Engines that send the new U.P. and Burlington Stream-Line Trains sailing over the rails at speeds of 70 to 100 miles an hour . . . must have constant and unfailing lubrication. Because of their simple design . . . their sturdy construction . . . their world-wide reputation for trouble-free service and long life . . . Viking Rotary Pumps were selected and installed on these new trains. The function of these pumps is to supply adequate lubricating oil to the big powered, high speed diesel engines. This is just another instance of the wide adaptability of the simple, sturdy Viking Rotary Pump.

Write today for FREE Folder.

VIKING PUMP COMPANY
Cedar Falls, Iowa

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BW Prints are true black and white positives—made directly from your tracings. With a simple, inexpensive developing machine you can produce them in your own blue print room, as speedily as you now make blue prints. Write us for complete information about BW.

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Since 1899

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BRUNING

prevent operation of the motor-driven machine.

In cases where it is desired, for safety reasons, to give preference to all "stop" buttons over any "start" button, the insertion of a padlock on the "stop" side of any of the push buttons will prevent operation of the motor-driven machine until the authorized person has removed the padlock and re-established the control circuit. In addition, this push button has been enclosed in a dust-tight and vaporproof enclosure, making it especially suitable for operation in dusty or gaseous locations.

Mercury Switch Is Metal Clad

METAL-CLAD mercury switches in a new line have been brought out by Jefferson Electric Co., Bellwood, Ill. The case of these new switches, shown herewith, is made of a specially selected iron which prevents amalgamation and which is treated to eliminate corrosion. Contact is mercury to mercury. The design permits operation through a narrow arc and the switch is compact. The switches are made in capacities up to 15 amperes and in several styles with one or two leads, grounded or insulated types, and in a number of sizes.

Specially selected iron used to prevent amalgamation is employed for the case of this mercury switch

Varied Plys Used in New Belts

FLEXING of the belt over small diameter pulleys is facilitated by the unique construction employed in the Monobelt manufactured by Alexander Brothers Inc., 406 N. West street, Philadelphia. In single ply belts, leather with a minimum of stretch is used. In double ply belts, the pulley side of the belt is made of the same leather as in a single ply, but the outer ply is made of more elastic leather, that is, leather having more elastic stretch than the inner ply. This construction is used to reduce internal friction.

The belt, made waterproof, is furnished in only one thickness for each width, thickness in-

Photograph of spring coil which has failed in service due to over-stress. Proper allowance for unavoidable variation in commercial wire stock would have eliminated the error.

ELIMINATING SPRING FAILURES

THE fact that springs play an important part in almost all machinery operation—and that uninterrupted performance depends entirely upon their ability to function without mishap—calls for careful and specific study of two important factors; correct design and correct application.

CORRECT design pertains not only to size and shape of the spring—as applying to the variable portion of stress—but, also, to load deflection characteristics due to any one of several reasons. Correct application means perfect coordination between spring and machinery designers—the development of an improved type of spring to eliminate trouble and failure in an existing product—or the planning of a new machine so as to assure sufficient space and other factors vital to efficient spring usage. It is the proved ability of the American Steel & Wire Company to properly design springs—and to assist in their correct application—that has made this source of supply the recognized leader.

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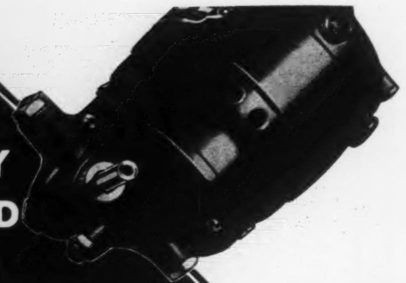

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down to
4 R. P. M.

Dumore motors are made in sizes up to ¾ H. P. In the smaller sizes they are available with built-in gear reduction units — gear ratios from 1089:1 to 2⅝:1 and gear shaft speeds from 4 to 3.000 R. P. M. Write for catalog giving complete data on sixty different sizes and types of Dumore Universal Motors.

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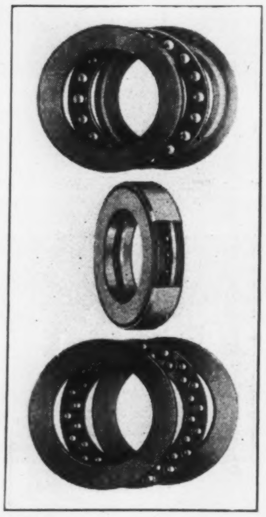
MOTORS



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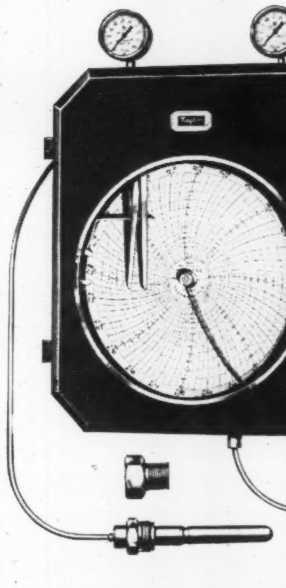
creasing with width. For conditions where the belt is subjected to reverse flexing, such as idler pulley or serpentine drives, this class of belt should not be used for reasons which are obvious.

Packing Ring Is Simplified

SPIRAL springs and fire or shock rings are eliminated by a new type of packing ring introduced by American Metallic Packing Co., Pittsburgh. Each ring is an individual casting of specially dense iron, and five rings constitute the standard installation. As the rings are produced carefully they are interchangeable.

Regulators Are Adjusted Easily

A FULL range sliding adjustment by which the regulator performance can be balanced for any degree of apparatus time lag is incorporated in the new Fulscope recording regulators for temperature, rate of flow, pressure or liquid level, being manufactured by Taylor Instrument Cos., Rochester, N. Y. A simple screwdriver adjustment on a graduated dial gives throttling or on-and-off diaphragm valve action, whichever provides the desired type of control. The regulator mechanisms and means of adjustment of all regulators in this line, shown herewith, are the same whether for controlling temperature, pressure, rate of flow or liquid level. They differ only in their means of actuation.

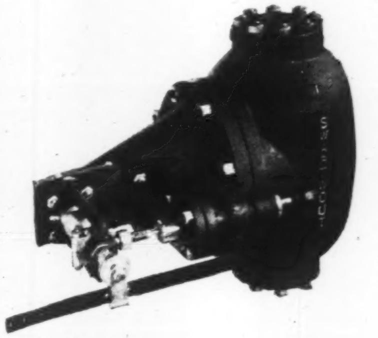


Regulation of the flow of air pressure to a diaphragm valve controls recording regulators which govern temperature, rate of flow, pressure or liquid level

Control of the units is maintained in the conventional manner by regulating the flow of air pressure to the diaphragm valve in the controlling medium line in response to changes in apparatus under control. Regulator action can be converted quickly from direct to reverse or vice versa without the addition or subtraction of parts. An electric chart-driving mechanism is standard equipment.

Unit Controls Liquid Levels

DESIGNED to control liquid levels in tanks, condensers, receivers and other vessels, the new unit developed by Swartout Co., 18511 Euclid avenue, Cleveland, will operate valves at any distance up to 300 feet, while the construction permits pressures up to 450 pounds. The float chamber of the control, shown herewith, is equipped with full ball bearing construction of stainless steel balls and races to eliminate friction caused by liquid under pressure. The operating mechanism is fully enclosed.

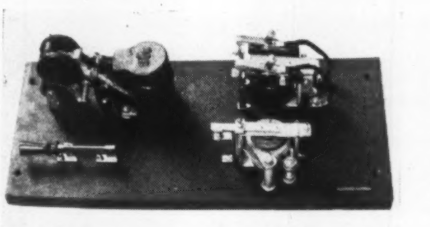


Full ball bearing construction of stainless steel balls and races combats friction in liquid level control

---

Relay Speeds Crane Lowering

THE new high speed lowering relay developed for cranes by Harnischfeger Corp., Milwaukee, consists of a single-pole, single-throw knife switch and a spring-closed contactor below which are a normally opened circuit relay and a standard two-pole control circuit relay. This lowering device, shown in the accompanying illustration, can be applied to any direct-current motor operated crane equipped with series motors and dynamic lowering control. The unit is entirely automatic, being controlled only by the



A single-pole, single-throw knife switch and a spring-closed contactor are employed in high speed lowering relay

If Your Machine Parts
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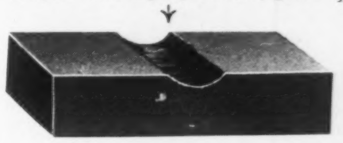
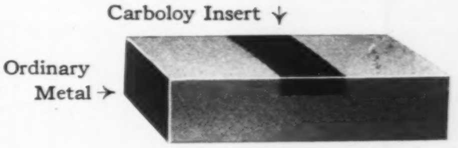
***Rapid* Abrasive Wear**

As, for example, on this part



Insert a Small Piece of
CARBOLOY Cemented Carbide
At The Point of Wear . . .



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The problem of rapid wear on your machine parts can be, in many cases, entirely eliminated simply by brazing in a small segment of Carboloy Cemented Carbide at the point of wear. Carboloy is extremely hard, rating approximately 91 on the Rockwell "A" scale ("C" scale —no load); it is 10 to 25 times more wear resistant than ordinary hard metal used on machine parts.

If one of your problems is to eliminate corrosive or abrasive wear at vital points on your machine parts, don't fail to investigate Carboloy cemented carbide. Complete information on request, without obligation.

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☐ Sketch enclosed of one of our parts, indicating point of rapid wear

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By V. M. FAIRES

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Professor Faires covers all the fundamentals of machine design including an initial review of "strengths". His book is unusually complete and will make a good reference as well as text. Especial points of excellence are: the chapters on gearing, containing material, not previously published in book form, on the latest advances in that field; the chapter on journal bearings with its new design information; and the chapter on welding which includes an explanation of the methods of computing stresses in welded joints. For the student it can be used either for the long or for the short course, and either before or after the study of "strengths".

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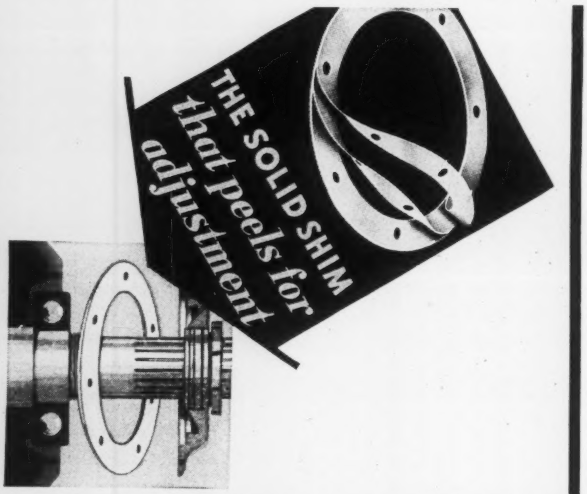

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227

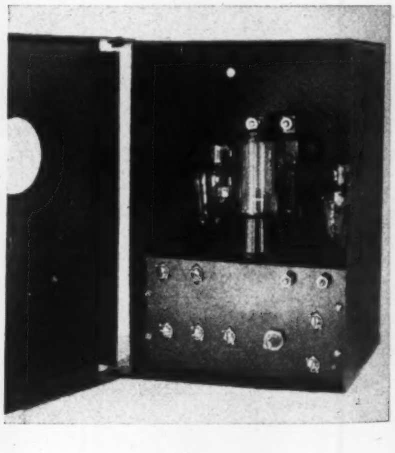
weight of the load itself. When the load is heavier than about one-third capacity, the relay automatically prevents the speed increase. With the device, the lowering speed of a hoist drive is increased without reducing the safety factor or minimizing the accuracy of control.

Hard-Facing Electrode Introduced

INTENDED for use for building up steel surfaces to resist shock and abrasion, the new Wearweld electrode, announced by Lincoln Electric Co., Cleveland, can be used on all steels other than those of the austenitic type. Deposits made with this electrode are air hardening alloy steel with a combination of hardness and toughness. A single layer on mild steel has a hardness of 40 to 45 Rockwell C. Additional layers will have a hardness of 48 to 52 Rockwell C. On 0.70 carbon steel, a single layer will have a hardness of 50 to 55 Rockwell C.

Photoelectric Relays Announced

IMPROVED photoelectric relays for general industrial use have been announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. The heavy duty contactor in the new LE relay, shown herewith, interrupts 20 amperes, 115 volt alternating current noninductive load or 3 amperes, 115 volt direct current. In applications such as counting, the operating speed ranges from 200 to 600 objects per minute, depending upon the amount of light change available and the resistance of the contacts.


Gas or vacuum phototubes can be used with improved photoelectric relays for general industrial use

Gas or vacuum phototubes can be used. A maximum of flexibility in the design allows either "on" or "off" operation of the contactor. The standard alternating current unit works on any frequency from 25 to 60 cycles, being equally sensitive throughout the range.

Patent Contracts Insure Legal Protection

(Concluded from Page 32)

ployer an implied license are based upon an *implied agreement* deduced by the circumstances, and, again, other decisions are based upon *estoppel.* Under the doctrine of estoppel, the moving factor appears to be that the employe allows the employer to enlarge his factory, spend money on advertising, etc., on a supposition of a right in the invention. This may happen to such extent that it would be inequitable to permit the employe to deny the existence of that right. Consequently, the law estops the employe from claiming that the employer has no right to use the invention. Under the doctrine of an implied agreement, the same results are reached as those reached by estoppel, but by different reasoning, in that there is an assumption that a promise exists, for the reason that the relationship indicates a tacit intent on the part of the employe that the employer may use the invention without paying him any royalties.

Definite Rights Govern

Aside from the doctrine of estoppel and implied agreement, the employer is given under certain conditions the right to use and vend the specific machines made by an employe through the provision of a federal statute, which reads, "Every person who *purchases* of the inventor, or discoverer, or with his knowledge and consent, *constructs* any newly invented or discovered machine, or other patentable article, *prior to the application by the inventor or discoverer for a patent,* or who sells or uses one so constructed, shall have the right to use and vend to others to be used, the specific thing so made or purchased without liability therefor."

Note that the statute is not invoked unless the purchase or construction of the newly invented machine occurs prior to the filing of a patent application for the machine. Whether or not this statute covers process inventions as well as mechanical inventions has never been definitely decided, for the reason that a process is neither an article nor a thing. It is a series of acts.

In those cases where the employer has a right to an employe's invention, the courts will compel the employe to make an assignment of the invention to the employer. However, the courts will not compel such assignments where the employer is insolvent or where the employer fails to pay the employe his salary.

Articles on this and allied subjects published in previous issues of Machine Design include:

"Careful Research Obviates Patent Pitfalls," March, 1933, p. 25; "Value of Patent Depends upon Efficient Claims," Aug., 1933, p. 13; and "Protect Your Right to a Valid Patent!" Nov., 1933, p. 24, all by George V. Woodling.

"Outstanding Patent Book Revised," Feb., 1934, p. 23.

"Patents, Inventions and Design Ingenuity Revitalized Under New Deal" (an editorial), March, 1934, p. 36.

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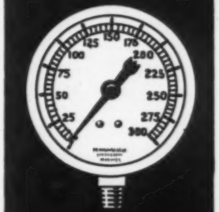

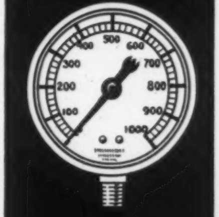

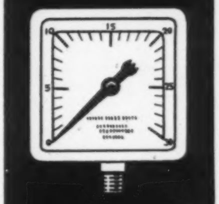

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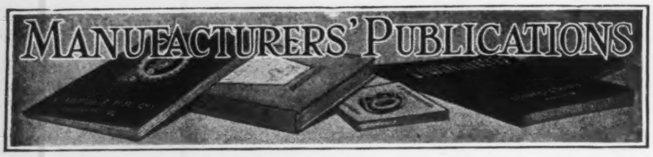


MANUFACTURERS' PUBLICATIONS

ALLOYS (STEEL)—To assist the engineer in the selection of the most suitable steel for a certain purpose, Wyckoff Drawn Steel Co., Ambridge, Pa., has prepared a wall chart listing S. A. E. steels. Included on the chart are hardness tables, relating Rockwell, scleroscope and brinell hardness numbers; tables giving weights of round, square and hexagon cold-drawn bars; and specifications for S. A. E. automotive steels.

ALLOYS (STEEL)—A series of cast nickel-chromium alloys made for resisting heat, corrosion or acids and available in six different analyses is described in a recent bulletin of American Manganese Steel Co., Chicago Heights, Ill. The bulletin illustrates applications and gives analysis characteristics for each of the alloys.

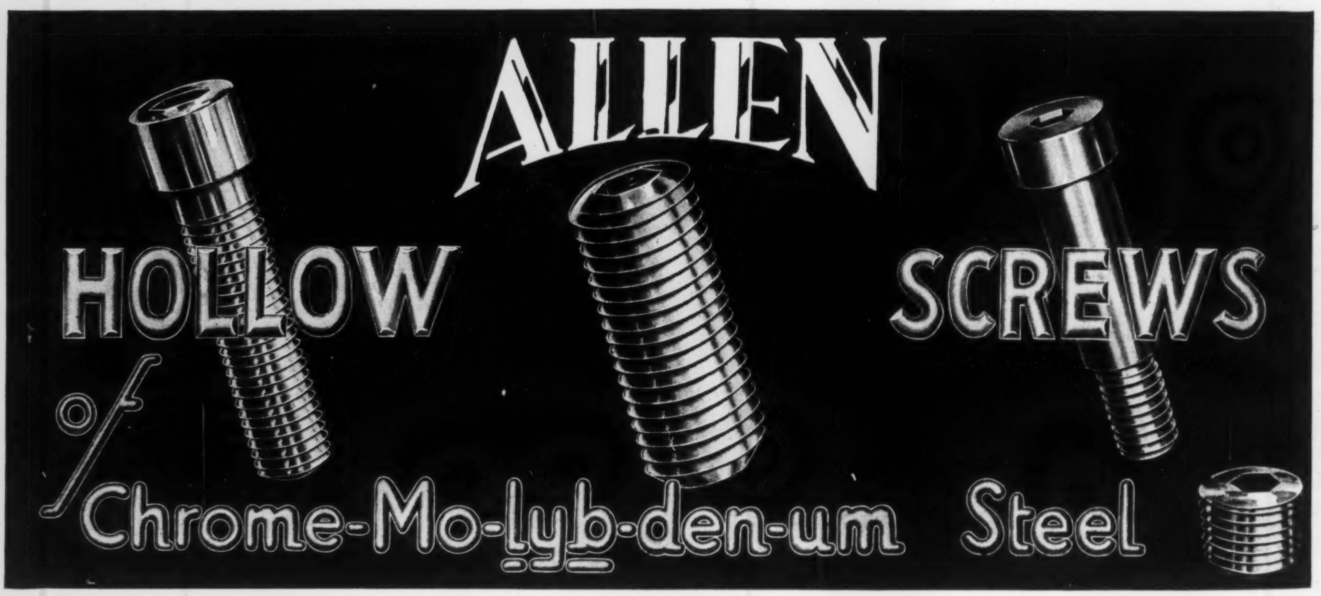
BEARINGS—Twentieth century bearings, full type, solid roller, self-contained bearings are announced in a recent bulletin of Roller Bearing Co. of America, Trenton, N. J. The bulletin gives a description of the bearing and includes tables of dimensions and sizes.

BEARINGS—New Departure Mfg. Co., Bristol, Conn., is distributing an exceptionally well-prepared booklet entitled "Bearings That Simplify Design." This booklet, demonstrating the special bearings developed for the axle engineer, includes two bearings which are new in design. The booklet is published in a limited edition, but copies are available to executive engineers in automotive companies.

COMPOSITION MATERIALS—Bakelite Corp., Bound Brook, N. J., has just issued a 48-page booklet on its molding materials which gives a complete description of the different types of materials manufactured by the company. Included in the booklet are the properties which can be attained in the finished part, methods of producing the parts and information on mold designs that should be avoided.

CONTROLS (ELECTRICAL)—Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is distributing a folder describing its new line of nonreversing magnetic time-starters. Designed for the remote control of constant and adjustable speed direct current motors in sizes up to 10 horsepower, 115 volts and 20 horsepower, 230 and 550 volts, they provide two points of definite magnetic time limit acceleration on motors of ten horsepower and below and three points of acceleration on 15 and 20 horsepower.

FASTENINGS—Complete information on Dardelet thread, the theory of the thread, its standardization, manufacture and application are given in a 216-page thread handbook recently issued by Dardelet Threadlock Corp.,



ALLEN'S adoption of Chrome-Molybdenum Steel has figured as a major factor in bringing the strength of hollow screws to a point adequate to the advanced requirements of present usage. Cold-worked and heat-treated by Allen processes, the hollow screw of Chrome-Molybdenum shows a 50% increase in tensile strength over Allen screws of steels formerly used, with a 25% gain in hardness. *No additional cost* to our users. » » »

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New York. Also included is general data on threaded fastenings, as well as a number of tables which are not usually found in a single handbook, including proportions and weights of bolts, nuts and screws, specifications for steel and other engineering data. The handbook will be sent free of charge to engineers responsible for design requesting it on their company letterhead.

GEARS—Horsburgh & Scott Co., Cleveland, has published a comprehensive 448-page catalog on gears which presents complete lists of all types of gears including nearly all numbers of teeth and listing both circular pitch and diametral pitch spur gears; latest gear engineering data, horsepower ratings and tooth loads for each gear listed; a complete hob list; a speed reducer engineering section, and speed reducer data.

HEATING UNITS—Edwin L. Wiegand Co., Pittsburgh, has prepared a 56-page file folder on its line of electric heating units which includes strip, cartridge, ring, platen, immersion and rod types. The folder gives the uses, construction and characteristics of the units. Temperature controls are described, and installation diagrams, wiring diagrams and engineering data are given.

HEATING UNITS—General Electric Co., Schenectady, N. Y., is distributing a most complete booklet on its line of electric heating units and devices. The booklet, which includes a presentation of controls designed for use with the units, describes and gives engineering data on cartridge, strip, calrod and immersion units, and cast-in heaters. Information is also given on the proper method of designing the part to be heated with one of the units.

MAGNESIUM—The uses, properties and fabrication of Downmetal, lightest of all structural metals, is presented in a new data book prepared by Downmetal division, Dow Chemical Co., Midland, Mich. In addition to a complete coverage of these phases in consideration of the material, the book gives information of fabrication processes, design data, physical property tables and sizes and technical functions of the structural shapes available.

MOTORS—Type CR single phase repulsion-start induction motors are described in a new leaflet of Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. These motors, especially designed for heavy industrial service, are available for 110-220 volt, 25-50-60 cycle service in sizes from ¾ to 3 horsepower.

SHAFTS—Cold finished shafting manufactured by Union Drawn Steel Co., Massillon, O., and special shafting is described in a recent bulletin of the company which gives manufacturing standards, physical properties, surface finish, recommended keyway sizes and similar information.

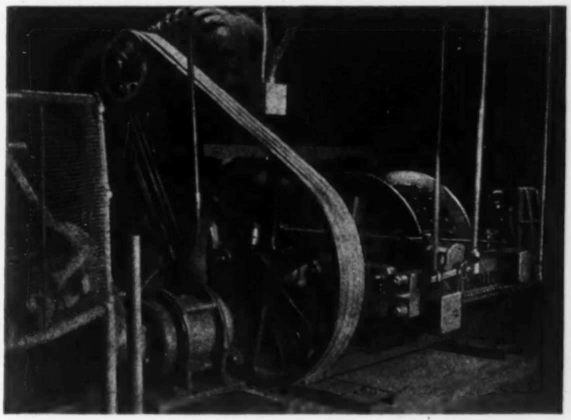
SHAPES—Complete information on the elements of light beams, stanchions and joists is given in a recent addition to the *Pocket Companion* published by Carnegie Steel Co., Pittsburgh, Pa.

ANOTHER LEWELLEN AUTOMATIC VENEER LATHE CONTROL

No more "diminishing returns" for this veneer manufacturer. With the Lewellen Automatic Veneer Lathe Control veneer is produced just as rapidly at the finish, or core of the log, as at the beginning of the cut. Some purchasers report an increase of 40% in production without added labor cost. He also produces a better quality of veneer because of the uniform cutting speed.

The control is entirely automatic, the spindle speed being automatically adjusted to the diameter of the log. When desired, the automatic control may be cut out by the throw of a switch, and any desired speed may be obtained by pressing a button.

When this special condition has passed, the switch may be thrown on and the lathe will automatically resume the proper speed for the diameter of the log.



The Lewellen Automatic Veneer Lathe Control installed at the Kentucky Veneer Works, Louisville, Ky. Increased production and improved quality of veneer was immediately noticeable. *"The Lewellen Control has already paid for itself"* is their verdict.

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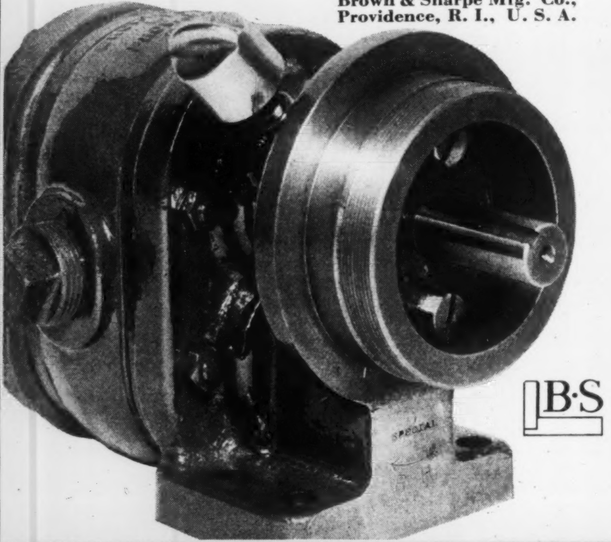

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Edited by Ernest E. Thum $5.00

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MACHINE DESIGN is a monthly technical publication conceived, edited and directed expressly for those executives and engineers responsible for the creation and improvement of machines built for sale, and for the selection of the materials and parts to be used.

BUSINESS ANNOUNCEMENTS AND SALES BRIEFS

FREDERICK W. BENSING has been appointed eastern sales manager of The C. F. Pease Co., Chicago, with offices at 254 Fourth avenue, New York.

* * *

Harold W. Faint is now a member of the sales engineering staff of Udylite Process Co., Detroit, with headquarters in the Chicago office of the company.

* * *

Charles A. Thomas has been appointed Detroit district sales manager of Mahoning Valley Steel Co., Niles, O., with offices at 2-228 General Motors building, Detroit.

* * *

Harvey Dietrich, manager of the structural department, Joseph T. Ryerson & Sons Inc., Chicago, has been made assistant vice president in charge of operations of the structural and special order departments in Chicago.

* * *

Revere Copper & Brass Inc., New York has announced the appointments of R. H. Binns, Jr., and S. H. Wilson as assistant general sales managers with headquarters in the general sales department, New York City building New York.

* * *

Ralph G. Caulley has joined the Detroit district sales office of Republic Steel Corp., Youngstown, O. Previously, for 14 years, Mr. Caulley was associated with Wheeling Steel Corp., Wheeling, W. Va., the latter half of this period in the Detroit district.

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David Adams has been appointed Pittsburgh district sales manager of Falk Corp., Milwaukee, succeeding W. O. Beyer. Mr. Adams has been with the Falk Corp. for the past four years in the sales department at Milwaukee Wis., and previously had been with National Malleable & Steel Castings Co., Sharon, Pa., and W. A. Riddel Co., Bucyrus, O.

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Bundy Tubing Co., manufacturer of welded steel tubing, has organized a subsidiary known as H. W. Bundy Inc. Officers of the new company are W. W. Anderson, president, T. M. Rude, vice president, A. C. Winger, secretary and treasurer, and H. J. Blair, superintendent. The subsidiary organization will take over the commercial parts copper-hydrogen-electric-welding production of the parent company other than tubing. General offices will be maintained at 10951 Hern avenue, Detroit.

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Orin F. Torborn is now representing Lamson & Sessions Bolt Co., of Birmingham, Ala., in Texas and the Southwest.

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Air Reduction Co. Inc., New York, has exercised its option on the balance of the capital stock of Wilson Welder & Metals Co., North Bergen, N. J., and thus becomes the first of the oxyacetylene welding companies to own a 100 per cent interest in an electric welding organization.

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Gueder, Paeschke & Frey Co., Milwaukee, stamped and pressed metal division, has made the following appointments of representatives: Arnold L. Nacke, 50 Church street, New York, for the metropolitan district; G. Douglas Morse, 542 High street, West Medford, Mass., for the New England district; and Gustav A. Reinhard, 1935 Euclid avenue, Cleveland, for the Cleveland district.

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Charles H. Dishman has been appointed district manager of sales for Granite City Steel Co., Granite City, Ill., with offices at 1805 Boatmen's Bank Building, St. Louis. He formerly was in charge of the company's Kansas City, Mo., office. Richard W. Orthwein, formerly in charge of the Dallas office, succeeds Mr. Dishman at Kansas City with offices at 916 Walnut street.

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Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y., has acquired from American Marsden Co., Jersey City, N. J., the sole manufacturing and sales rights in the United States of the Marsden locknut. A Marsden locknut division has been created at Port Chester for the development of the business. C. E. S. Place, formerly chief engineer of the Marsden company, now is associated with Russell, Burdsall & Ward in connection with the new division.